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CONTENTS.

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICES—

Thirtieth Annual Meeting of the New England Association of Gas Engineers 281

Seventh Annual Meeting, Michigan Gas Association 282

EDITORIALS—

Briefly Told 282

The Thirtieth Annual Meeting of the New England Association of Gas Engineers—The Seventh Annual Meeting of the Michigan Association—He is Now President—Notes.

The Illuminating Power and Color of the "Kugel" High Pressure Gas Light 282

Text of the Decision of the Massachusetts Board of Gas and Electric Light Commissioners in Respect of the Application of the Authorities of Haverhill for a Cheaper Gas Rate 285

Relation of Coke Producers to Consumers, by Mr. E. M. Peters 285

A Method for the Estimation of Ferrocyanides in Old Purifying Materials, by E. Donath and B. M. Margosches 287

Quicksand 287

*The Diesel Oil Engine 288

ITEMS OF INTEREST FROM VARIOUS LOCALITIES 292

Annual Meeting, West Chester, Pa.—Extending the Business of the Beverly (Mass.) Company—Death of Mr. Geo. H. Norman—Recapitalizing the Wilmington (N.C.) Gas Company—Proposed Public Works for Puetro Principe Cuba—An Interesting Suit, Detroit, Mich.—Mr. Walker Takes Charge at Rockville, Conn.—Annual Meeting, Washington, D. C.—Progress in Gas Trade, Des Moines, Ia.—Annual Meeting, Independence, Mo.—The Stevens Gas Improvement Company—Gas Works for La Grange, Ills—A Liberal Proposition by President Poor—Incandescent Gas Light and Vegetable Growth—Contract for the Berlin Iron Bridge Company—Proposed Gas Inspector for Atlanta, Ga.—An Electric Lighting Company Goes Out of Business—Something from the Annual Report, Peoples Company, Chicago—And Other Items.

The Market for Gas Securities 293

[OFFICIAL NOTICE.]

Thirtieth Annual Meeting of the New England Association of Gas Engineers.

NEW ENGLAND ASSOCIATION OF GAS ENGINEERS,
OFFICE OF THE SECRETARY,
NEW BEDFORD, MASS., Feb. 6, 1900.

To the Members of the New England Association of Gas Engineers: The Thirtieth Annual Meeting of the Association will be held at Young's Hotel, Boston, on Wednesday and Thursday, February 21st and 22d. The call to order will be made at 10 A.M.

Members will please gather promptly in the meeting room (No. 12), so that the sessions may not be delayed.

The following papers are to be read:

"Then, Now and Later;" by Mr. John A. Waters, Stamford, Conn.

"Four Years' Experience with Prepayment Meters;" by Mr. N. O. Goulding, Natick, Mass.

"Pumping Gas Five Miles, at 20 Pounds Pressure;" by Mr. F. H. Shelton, Philadelphia.

"Some Notes on Oil and Tar Burning;" by Mr. B. J. Allen, Allston, Mass.

The Question Box content so far is as follows:

"What successful substitute for cast iron gas mains has the high price of iron developed?"

"Would a gas inspector be justified in 'passing' a job that had been made tight through healing a leak by cold water application?"

"Are wrought iron or steel tanks set on surface of ground considered better than brick and cement, or stone or cement tanks set in the ground, for gasholders? And is there much difficulty in the construction of the latter to prevent leakage?"

"In double stacks of retorts, which arrangement is preferable: To have the benches set back-to-back, or facing each other, with operating floor between?"

"At what price can gas be produced by any of the acetylene gas machines?"

"At what price per net ton does anthracite coal have to be delivered to equal gas at $1 per 1,000 cubic feet for cooking purposes?"

Topics suggested for discussion are:

"Coke Oven and Retort House Construction and Results."

"Under-water Gas Main Construction."

Eminent gas engineers and constructors have consented to start discussion on the named topics.

Members are urged to send in their questions for the Box well before the meeting, that they may be published, thus giving all a chance to join intelligently in one of the most useful features of the meeting.

It is suggested that members wear their badges at the meeting. Badges may be secured from the Treasurer.

The members will dine together as usual on Wednesday evening. Blank applications for membership may be obtained of the Secretary, and all matter to come before the Directors should be forwarded to the Secretary, not later than February 20th.

Friends of the Association are invited to attend the meeting.

N. W. GIFFORD, Secretary.

[Official Notice.]

Seventh Annual Meeting, Michigan Gas Association.

Michigan Gas Association,
Office of the Secretary,
Racine, Wis., Jan. 17, 1900.

To the Members of the Michigan Gas Association: The Seventh Annual Meeting of the Michigan Gas Association will be held in the city of Detroit, on Wednesday, the 21st, and Thursday, the 22d day of February next. Headquarters will be at the Russell House, where also the meetings of the convention will be held. Rates $3.50 and upwards per day for room with bath, and $2.50 and upwards without bath.

H. H. Hyde, Secretary.

BRIEFLY TOLD.

The Thirtieth Annual Meeting of the New England Association of Gas Engineers.—This week the New England Association will assemble in Thirtieth Annual Convention, and Secretary Gifford's official notices show that nothing has been left undone in the way of attending to preliminaries to ensure a meeting that shall be in every sense successful and instructive. The set paper list contains four numbers, the question-box is well filled with hard nuts, and the two named topics have enough in themselves to maintain a spirited debate for a good bit of time. Added to the matters for discussion enumerated must be remembered, in connection with the interest that attaches to the business sessions, the address of the President, Mr. Walter R. Addicks, whose annual message will be listened to eagerly. A man of culture, of study, and of application, his references to the present status of the gas industry in Massachusetts, viewed through the odd attacks, odd perhaps more in the sense that these now seem to be concerted rather than sporadic, by the authorities of a score of populous centers on their respective gas companies, as to the rates at which gas may be supplied, will receive more than passing attention. That he will handle the question without passion and with dignity is conceded. The meeting, from present indications, bids fair to be a most eventful one in the history of the Association.

The Seventh Annual Meeting of the Michigan Association.—While the New England Association is in session in Boston, the Michigan Gas Association will be carrying on its seventh annual conclave in Detroit. It is to be regretted that the dates of these meetings clash, but as it has been so ordained by the Michigan men, there's the end of it. Secretary Hyde's notices have not been prolific in the matter of particulars as to the papers, but it may be taken for granted that President Walker and the others of the Association's executives have not been idle in the instance of getting together sufficient matter to cause those who will be in attendance at the Russell House to regret such visit.

He is Now President Harbison.—If nothing succeeds like success, then Mr. John P. Harbison, of the Hartford (Conn.) City Gas Light Company, must be accounted signally successful. On December 1st, 1855, he entered the Company's employ as a clerk, on two weeks' probation; January, 1864, he was elected its Secretary; in March, 1866, he was formally appointed Superintendent, vice Mr. Thomas R. Dutton, deceased; in January, 1880, he was elected its Treasurer and General Manager; and on the 10th inst., he was unanimously chosen President. Ex-Governor Howard declined to continue longer as the chief executive of the Company, whose aims and purposes he has during his long term of office successfully upheld—he still remains on the Board. That President Harbison will be a success goes without saying; that his presidency may be for many years also goes unspoken.

Notes.—The lamentable death of Mr. James Gardner, Jr., will make no change in the operation of the fire clay goods plant at Lockport Station, Pa., for so many years in the control of his family. The business management of the Lockport plant and the Pittsburg offices will, as heretofore, remain in the direct charge of Mr. E. H. Henderson.——Mayor Utter, of Hawthorne, N. J., a suburb of Paterson, has vetoed the ordinance of Council granting to Mr. Van Steenberg and his associates the right to supply gas in the place named.——The Cleveland (O.) Gas Light and Coke Company does not seem to anticipate going out of business just yet, for it has just purchased a good sized tract of land adjoining its No. II. works.

The Illuminating Power and Color of the "Kugel" High Pressure Gas Light.[1]

Dr. H. Bunte and Dr. P. Eitner, of Carlsruhe, have recently published in the *Journal für Gasbeleuchtung* an account of an exhaustive investigation of the illuminating power and color of one form of intensified gas light. The work was undertaken at the desire of the "Kugel" Light Company, of Dresden, with the so-called "Kugel" or "Ball" light, invented by Herr Salzenberg, Manager of the Crefeld Gas Works. This light is essentially a high pressure gas light, in which gas pressures of 1 atmosphere and upwards can be employed and specially good results secured. The report of the investigation is of general interest, as such researches hitherto have been of a disjointed character. The work was directed chiefly to the following points: (1) Ascertaining the illuminating power at various gas pressures, the rate of consumption, the composition of the gas, and of the mixture of gas and air in the burners. (2) Determining the illuminating power at different angles. (3) Comparing spectrophotometrically the Kugel light, high pressure gas light, ordinary incandescent gas light, and the Hefner light.

The determination of illuminating power was made by direct comparison of the light of a Kugel burner with the light of a standardized Hefner amyl acetate lamp, consuming amyl acetate of standard quality. A Kruss's Lummer-Brodhun sighting box, the equality of the two sides of which had been proved, was used for making the comparison; and the Hefner lamp was placed at a distance of 300 mm. (nearly 12 inches). The distance of the Kugel light was afterwards measured, and its illuminating power calculated therefrom. The pressure of the gas was ascertained by means of a mercury pressure gauge, which was directly connected just below the nozzle of the burner. The Kugel burner had a double mantle made by Messrs. Feuer, of Berlin. Five observations were taken in each case; and each figure recorded below is the mean of the five results.

In order to determine the rate of consumption, the top of the burner and the mantle were removed; and the air inlet holes of the bunsen were closed with putty, so that they were gas tight. The top of the bunsen tube was then connected with the inlet of an experimental gas meter; and the gas issuing from the outlet of the meter was led off into the open. The meter, etc., threw a back pressure of at the most some 4 inches of water; and this would about compensate for the resistance ordinarily offered by the burner-top and the mantle. Two observations of the rate of consumption were made in each case; and the meter was verified before and after each observation. Each figure stated below is the mean of the two results.

The figures given in the original table have been converted into English terms on the assumption that 1 Hefner-unit equals 0.877 English sperm candle. The results of the observations then become as follows:

Pressure of the Gas. Atmospheres.	Illuminating Power. English Candles.	Rate of Consumption. Cub. Ft. per Hour.	Efficiency. Candles per Cub. Ft.
0.2	290 7	15.70	18.5
0.4	465.9	24.01	19.4
0.6	649.2	29.67	21.9
0.8	818.3	34.80	23.5
1.0	904.5	39.20	23.1
1.1	1033.0	41.32	25.0
1.2	1080.1	43.53	24.8
1.4	1140.5	47.59	24.0

At the normal working pressure of 1.1 atmospheres, the Kugel light therefore gives an illuminating power of 1033 candles, which is higher than that hitherto afforded by single incandescent gas lights, and at the present time can be attained practically only by means of the electric arc lamp. The value 904.5 candles found for 1 atmosphere pressure, clearly was lower than it should be, though no reason could be given to account for the discrepancy. The efficiency is highest at a gas pressure of 1 1 atmospheres, and is then very high. For instance, good new [German] Welsbach burners show an efficiency of about 17 candles per cubic foot; while the Pintsch high pressure gas burner, working at 0.2 atmosphere pressure, yields about 220 candle power for a consumption of 9.36 cubic feet per hour, which indicates an efficiency of about 23.4 candles per cubic foot of gas. The results of the examination showed that the Kugel burner afforded a very economical utilization of the gas, with the production of a light of great intensity and of a yellowish tint.

For the sake of completeness, the composition of the gas used was determined; and the following shows the percentage by volume of the several constituents: Carbonic acid 2 2, heavy hydrocarbons 3 4,

1. *Journal of Gas Lighting*,.

carbonic oxide 7.7, methane 32 3, hydrogen 52, and nitrogen (with traces of oxygen) 2.4. The gas under high pressure had the same composition, but constantly contained some air. Even after repeated exhaustion and refilling of the compressing cylinder, about 4.5 per cent. of air was discovered in the high pressure gas. In order to find the composition of the mixture of gas and air in the burners, they were set up but not lighted; and samples of the gaseous mixture were withdrawn from the interior of the mantle by means of a capillary tube, and subjected to analysis. The following percentages by volume of gas and air were found under the stated conditions:

	Kugel Burner.		Pintsch's High Pressure Gas Burner.	Welsbach Burner.
Pressure of gas.....	0.2 atmosphere	1.1 atmosphere	0.2 atmosphere	14 10th of water
Gas.....	22.87	13.88	13.54	22.5
Air.....	77.13	86.12	86.46	77.5

The distribution of the light was observed by means of Kruss's radial photometer. For the sake of comparison, some observations were also made, with an Elster radial photometer, on the distribution of the light from the Welsbach burner. The results are shown in the appended table, in which 0° signifies vertically beneath the burner, 90° the horizontal plane, and 180° vertically above the burner. As the figures were required only for comparison with one another, the absorption factor of the mirror of the radial photometer was not ascertained.

sumption was 7.14 cubic feet per hour. In order to obtain mantles of identical quality, the unprepared fabrics were impregnated carefully with a 30 per cent. solution of the nitrates of thorium and cerium, in such proportions as would (on incineration) yield a mantle consisting of 98.75 per cent. of thorium oxide and 1.25 per cent. of cerium oxide. A special spectrophotometer was devised for the work, in order that the intensity of the similar rays from different sources might be directly compared. The light of the source under investigation was broken up by a prism into its components, in such a manner that two colored bands—one above the other—were obtained. The one band was the light of the standard lamp, the other the light of the source under comparison. Similar colors were precisely above one another. By means of an eye slit, any portion of the spectrum could be examined, apart from the rest, at will. The position of the portion of the spectrum under examination could be determined by means of a scale. The measurements were made in each case in the red, yellow, green, blue and violet portions; and the range over which they extended comprised the six divisions of Bunsen's spectroscope scale. The comparisons were made at first with a standardized Hefner lamp, burning amyl acetate which had on testing been found to be of normal quality. The pressure of the gas was observed on a mercury pressure gauge. The results given in the subjoined table show the intensity of the source of light in each color, when the intensity of the Hefner light in the same color was taken as unity. Each figure given is the mean of two observations; and the sighting box was reversed between the two readings.

At the high gas pressure of 1.1 atmospheres, efficiency is lost when the simple mantle is used, as the flame passes completely through it;

Angle, Degrees.	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160
Illuminating power, English candles—																
Kugel.....	66.9	126.3	185.2	251.4	294.8	316.6	358.0	356.7	388.0	386.7	363.8	333.5	306.7	257.5	215.3	158.3
Welsbach.....	..	8.5	15.8	23.3	30.3	36.0	..	.	46.5	..	..	..	..	..	..	..

Color of the Light.	Position According to Bunsen's Spectroscope Scale.	Mean Wave Length of the Light.	Intensity (Hefner Lamp = 1).					
			Welsbach Light, 2 Inches of Water Pressure.	High Pressure Gas, 0.2 Atmosphere Pressure.	Kugel Light, with Double Mantle, at 1.1 Atmos. Pressure	Kugel Light, with Double Mantle, at 0.2 Atmos. Press.	Kugel Light, with Simple Mantle, at 0.2 Atmos. Press.	Kugel Light, with Simple Mantle, at 1.1 Atmos. Pressure.
Red.....	32.0	670 $\mu\mu$	31.1	160.4	421.2	183.9	308.3	120.6
Yellow	50.0	589 "	44.9	252.9	578.2	256.3	431.5	183.5
Green	65.5	540 "	59.5	319.7	710.5	304.3	544 0	229.1
Blue.....	95.5	477 "	73.9	484.3	986.6	376.8	823.6	321.5
Violet	126.0	434 "	64.1	529.0	1,053.6	444.5	945.6	341.2

These figures indicate, as may readily be seen diagramatically, that the Kugel burner affords a more uniform distribution of light than does the Welsbach burner. The reason for this difference may be traced in the longer mantle of the Kugel light, and the globular shape which it assumes on use, especially in its upper half. The radiation thus occurs from a globular surface. The bulging of the mantle is not due to the asbestos fibers by which it is supported, nor does it return to its original form when the pressure is discontinued.

With regard to the color of the Kugel light, it has been noticed at the Crefeld gas works—where it is used side by side with the ordinary Welsbach light—that it has an agreeably warm yellowish tint, while the latter is of the well known peculiar greenish color.

The impression is not the result of an optical illusion due to the great difference in the intensities of the two lights, for the same variation in tint is observed when the lights are compared on the photometer and the disc is equally illuminated by them. The difference in this case resembles that which occurs when the Welsbach light is compared with the light of the Hefner lamp. The ordinary high pressure (0.2 atmosphere) gas light resembles the Welsbach light in color; and it therefore becomes pertinent to ask if the special color of the "Kugel" light is to be traced to the high gas pressure of 1.1 atmospheres. This question was first attacked by making spectrophotometric observations of the Kugel light, the high pressure gas light and the Welsbach light, with mantles prepared in precisely the same manner and of the same composition, and using different gas pressures.

The high pressure gas light, with 0.2 atmosphere pressure of gas, was obtained by means of an incandescent burner, the orifices of the nipple of which had been reduced in size, until, at the pressure named, the burner consumed about 7 cubic feet of gas per hour and was adapted for the use of a simple mantle. In the tests, the actual rate of consumption was 7.14 cubic feet per hour. In order to obtain mantles of identical quality, the unprepared fabrics were impregnated carefully with a 30 per cent. solution of the nitrates of thorium and cerium, in such proportions as would (on incineration) yield a mantle consisting of 98.75 per cent. of thorium oxide and 1.25 per cent. of cerium oxide. A special spectrophotometer was devised for the work, in order that the intensity of the similar rays from different sources might be directly compared. The light of the source under investigation was broken up by a prism into its components, in such a manner that two colored bands—one above the other—were obtained. The one band was the light of the standard lamp, the other the light of the source under comparison. Similar colors were precisely above one another. By means of an eye slit, any portion of the spectrum could be examined, apart from the rest, at will. The position of the portion of the spectrum under examination could be determined by means of a scale. The measurements were made in each case in the red, yellow, green, blue and violet portions; and the range over which they extended comprised the six divisions of Bunsen's spectroscope scale. The comparisons were made at first with a standardized Hefner lamp, burning amyl acetate which had on testing been found to be of normal quality. The pressure of the gas was observed on a mercury pressure gauge. The results given in the subjoined table show the intensity of the source of light in each color, when the intensity of the Hefner light in the same color was taken as unity. Each figure given is the mean of two observations; and the sighting box was reversed between the two readings.

At the high gas pressure of 1.1 atmospheres, efficiency is lost when the simple mantle is used, as the flame passes completely through it; hence the figures are much lower than when the double mantle is used. The table indicates clearly that, with all the lights examined, the intensity, relative to that of the Hefner light, rises from the red to the blue end of the spectrum. The purport of these figures will be seen more clearly from the following table, which is deduced from the preceding one, and expresses the intensity for each source of light in terms of the intensity of the same source in the red. The Hefner light remains the unit of comparison in all colors.

Color of the Light.	Position According to Bunsen's Scale	Intensity, compared with that of the Hefner Light.					
		Welsbach Light; 2 Inches of Water Pressure.	High Pressure Gas; 0.2 Atmos. Pressure.	Kugel Light.			
				Double Mantle.		Simple Mantle.	
				1.1 Atmos. Pressure.	0.2 Atmos. Pressure.	0.2 Atmos. Pressure.	1.1 Atmos. Pressure.
Red....	32.0	1.000	1.000	1.000	1.000	1.000	1.000
Yellow.	50.0	1.144	1.571	1.373	1.394	1.400	1.522
Green ..	65.5	1.913	1.993	1.687	1.655	1.765	1.900
Blue ...	95.5	2.376	3.019	2.342	2.049	2.672	2.666
Violet..	126.0	2.061	3.298	2.501	2.417	3.067	2.829

There is a remarkable concordance between all these figures, with the single exception of those for the ordinary Welsbach light, which show a decreased intensity in the violet. The comparison indicates that the high pressure gas light should appear bluish, the Welsbach light greenish, and the Kugel light with the double mantle reddish in tone. The Kugel light with simple mantle closely resembles the high-pressure gas light. The difference towards the blue and violet is not, however, so great as it seems; for the Hefner light, which forms the basis of comparison, is very poor in blue and violet rays. In order to gain a proper impression of the relative color of the high pressure gas light, the Kugel light, and the Welsbach light, the first two were compared spectrophotometrically with the last. In addition, from the

figures already obtained in the comparisons with the Hefner lamp, the intensity of the first two in the different colors was calculated in terms of the intensity of the Welsbach light, regarded as unity for all colors. In the direct comparisons, six observations were made; and the means are—

Color of the Light.	Position according to Bunsen's Scale.	Intensity (the Intensity of the Welsbach Light = 1). By Calculation from the Hefner Light Results. Kugel Light. Double Mantle. Pressures 0.2 Atmos.	Kugel Light. Double Mantle. 1.1 Atmos.	Kugel Light. Simple Mantle. 0.2 Atmos.	Kugel Light. Simple Mantle. 1.1 Atmos.	High Pressure Gas Light. 0.2 Atmos.	High Pressure Gas Light. 0.2 Atmos	By Direct Observation. Kugel Light, Double Mantle. 1.1 Atmos.
Red....	32.0	5.913	13.543	9.913	3.878	5.158	3.751	17.832
Yellow.	50.0	5.703	12.866	9.602	4.083	5.628	3.803	15.414
Green..	65.5	5.114	11.941	9.143	3.851	5.373	3.853	17.043
Blue ...	95.5	5.099	13.351	11.145	4.351	6.553	4.179	18.533
Violet..	126.0	6.934	16.437	14.752	5.323	8.253	5.013	20.753

Here, however, as in the case of the Hefner lamp comparisons, the true relation between the colors is not readily seen until only such an amount of light is contemplated as gives equal intensity in one color. If, therefore, the intensity of color of the lights compared with the Welsbach light is expressed in terms of the intensity in the red, which is taken as unity, the following values are obtained:

Color of the Light.	Position According to Bunsen's Scale.	Intensity, Compared with that of the Welsbach Light. By Calculation from the Hefner Light Results. Kugel Light. Double Mantle. Pressures 0.2 Atm.	Kugel Light. Double Mantle. 1.1 Atm..	Kugel Light. Simple Mantle. 0.2 Atm.	Kugel Light. Simple Mantle. 1.1 Atm.	High Pressure Gaslight. 0.2 Atm.	High Pressure Gaslight. 0.2 Atm.	By Direct Observation. Kugel Light, Double Mantle. 1.1 Atm.
Red.....	32.0	1.000	1 000	1 000	1 000	1.000	1 000	1.000
Yellow.....	50.0	0.965	0 950	0 969	1.053	1 091	1.014	0 862
Green	65 5	0 865	0 882	0 922	0 993	1.042	1.027	0 953
Blue	95 5	0.862	0.986	1.124	1.122	1.271	1.114	1.036
Violet	126 0	1.173	1.214	1.488	1.373	1.600	1.336	1.161

These figures show a remarkable concordance. It is, however, again apparent that the Kugel light with a simple mantle closely resembles the high-pressure gaslight, and that they are both distinguished from the Kugel light with double mantle by the blueness of their tone.

The Kugel light was next compared spectrophotometrically with the high pressure gaslight. Six observations were made in each case; and the mean results are recorded in the first of the two cross-page tables at foot, in which also values deduced from the preceding comparisons with the Hefner lamp and the Welsbach light are included. If, again, the quantity of light in the red in each case is taken as 1, the relations between the colors are shown more clearly, as in the second cross-page table. Finally, by deducing the mean values from the results of the different observations, the summary appended, showing the relations between the color intensities of the lights, is obtained. The Kugel light is here taken only when working with a double mantle, and at its normal pressure of 1.1 atmospheres. The final figures of the summary show clearly that the high pressure gaslight is bluish, and the Kugel light reddish, in tone compared with the Welsbach light; while the Kugel light is also reddish in comparison with the high-pressure gas light. The investigation, however, has shown that the reddish color of the Kugel light does not arise simply from the high gas pressure of 1.1 atmospheres which is employed. The figures show that the Kugel light with the double mantle, working at 0 2 atmosphere pressure, is even redder than when the same mantle is used at the higher pressure of 1.1

Color of the Light.	Position According to Bunsen's Scale.	Comparison with the Welsbach Light. High-Pressure Gaslight.	Comparison with the Welsbach Light. Kugel Light.	Comparison with the High-Pressure Gaslight. Kugel Light.
Red	32.0	1 000	1.000	1.000
Yellow.....	50.0	1.053	0.906	0 881
Green	65 5	1.035	0.918	0.901
Blue	95.5	1.193	1.011	0 874
Violet.....	126.0	1.468	1.188	0.829

atmospheres; while, on the other hand, the Kugel light with the simple mantle is, either at 1.1 or 0.2 atmosphere pressure, very similar in tone to the high pressure gaslight. The reddish color of the Kugel light, therefore, arises chiefly from the mantle used. In the first place, the mantle is double; in the second place, it is of compact structure. The weight of the incinerated Kugel mantle is 3.838 grammes, which is about seven times the weight of an ordinary mantle. But though the reddish tone of the Kugel light cannot be directly ascribed to the high gas pressure of 1 to 1.1 atmospheres, yet it actually depends indirectly on the pressure. The mantle, in order that it may be durable under

Color of the Light.	Position According to Bunsen's Scale.	Intensity (the Intensity of the High-Pressure Gaslight 1). By Direct Observation.	By Calculation from the Welsbach Light Comparisons.	By Calculation from the Hefner Lamp Comparisons. Kugel Light, Double Mantle. Pressures 1.1 Atm.	Kugel Light, Double Mantle. 1.1 Atm.	Kugel Light, Double Mantle. 0.2 Atm.	Kugel Light, Double Mantle. 1.1 Atm.	Kugle Light, Simple Mantle. 0.2 Atm.	Kugle Light, Simple Mantle. 1.1 Atm.
Red.....	32.0	3.374	4.767		1.147	2.626		1.992	0.752
Yellow	50.0	3.106	4.053		1.013	2 286		1.706	0.726
Green.....	65.5	3 133	4 423		0.952	2.222		1.702	0.717
Blue.....	95 5	3.093	4 436		0.778	2 037		1.701	0.664
Violet.....	126.0	2.905	4.140		0.840	1.992		1.788	0.645

Color of the Light.	Position According to Bunsen's Scale.	Intensity Compared with that of the High-Pressure Gaslight. By Direct Observation.	By Calculation from the Welsbach Light Comparisons.	By Calculation from the Hefner Lamp Comparisons. Kugel Light, Double Mantle. Pressures 1.1 Atm.	Kugel Light, Double Mantle. 1.1 Atm.	Kugel Light, Double Mantle. 0.2 Atm.	Kugel Light, Double Mantle. 1.1 Atm.	Kugel Light, Simple Mantle. 0.2 Atm.	Kugel Light, Simple Mantle. 1.1 Atm.
Red	32.0	1.000	1.000		1.000	1.000	1-000	1.000	1.000
Yellow.....	50 0	0 921	0.850		0.884	0.871		0 888	0.965
Green.....	65.5	0 929	0.928		0.830	0.846		0.885	0 953
Blue.....	95 5	0.917	0.930		0 679	0.776		0.885	0.883
Violet.....	126.0	0.861	0.869		0.733	0.758		0 930	0.858

this high pressure, must be of so compact a structure that it necessarily radiates yellowish or reddish light. Such a mantle would be no novelty applied to the ordinary high-pressure gaslights and incandescent burners; and with it they would similarly yield a reddish light. But the use of this mantle at a low pressure would be highly irrational, for a far lower illuminating power would be obtained than with the ordinary mantle giving a greenish light. For instance, a simple Kugel light mantle, used on a high-pressure gas burner at 0.2 atmosphere pressure, afforded a duty of only 10.05 candles per cubic foot of gas consumed; whereas the same mantle employed at 1 1 atmospheres pressure, as in the Kugel light, showed a duty of 25 candles per cubic foot.

The results of the investigations described in the foregoing report may be summed up as follows:

1. The application of 1 to 1.1 atmospheres gas pressure enables a very high duty to be economically obtained from the gas.
2. The aforesaid high gas pressure gives a rather more uniform distribution of the light than is obtained with the Welsbach light. This difference is due to the high pressure and velocity of the effluent gas causing the greatest intensity of the flame to be transferred to a higher position, and to the bulging of the mantle which is effected thereby.
3. The aforesaid high gas pressure makes it possible to obtain an agreeable yellowish light concurrently with a very high illuminating duty from the gas consumed.

Text of the Decision of the Massachusetts Board of Gas and Electric Light Commissioners in Respect of the Application of the Authorities of Haverhill for a Cheaper Gas Rate.

The Board reports: The Haverhill Gas Light Company was organized under a special charter, in February, 1853, and later in that year began the supply of gas in Haverhill. Its capital stock was originally $45,000, which was increased in 1871 to $75,000, its present amount It has enjoyed the exclusive privilege of supplying gas to the city and people of Haverhill, and with the exception of a period in its earliest history, has been uniformly prosperous. Its management appears to have been exceptionally careful and conservative, so that in addition to the payment of an average dividend of about 8 per cent. it has accumulated a surplus, invested in its plant, estimated to represent from $275,000 to $300,000.

It is probable that a part of this will disappear in the near future through the abandonment of existing plant in making improvements which are likely to prove necessary for properly supplying the public, but the surplus is much larger than can be utilized for any such purpose. It is unnecessary at this time to give particular consideration to the wisdom or unwisdom of creating a surplus of this size and character, but rather to consider how it has arisen and how it should be treated as an existing fact. It does not appear that it is due to extravagant prices for gas or to a niggardly policy toward the public; the prices have, in fact, been as low or lower than in other companies of its class in the State, while the quality of the service, so far as the Board has been able to ascertain, has been equal to the best.

This accumulation appears rather to have been due in part to exceptional care in the management, and in part to a rapid gain in wealth and population in the community supplied. Its growth has been steady through a long series of years, and not excessive in any single year. Its existence thus appears to be due in part to causes over which the Company has had no control, and for which it is entitled to no particular credit. Accumulated, as it has been, out of profits in the performance of a public service, its existence affords exceptional facilities and imposes peculiar duties upon the corporation toward the public.

As the Company has applied this surplus to the cost of improving and enlarging its plant, as needed to satisfy the public demand, the property in which it has been invested must otherwise have been represented by new capital contributed by the shareholders. Such use of surplus may properly be made of substantial benefit to the consumers and shareholders alike. To the former, by relieving them of some portion of the burden which the investment of fresh capital necessarily imposes, by affording the most ready facility for minor extensions to the Company's lines, for superior excellence in its product and by aiding to the most satisfactory performance of its varied duties toward the public; to the latter, by strengthening the corporation in enhancing the security of the original investments of the shareholders, and in bringing to them a return somewhat higher than that to which they might otherwise be entitled.

Such a surplus is, by every principle of law, the property of the corporation. It has an undoubted legal right to distribute it as a dividend as it is acquired or pro rata to its shareholders in case of liquidation, but notwithstanding this, the circumstances attending its accumulation impose upon the Company, so long as it continues to exercise the functions of a public monopoly, the duty to employ it for the joint advantage of the consumers and the corporation. It need not be dealt with as the exclusive property of either.

Fortunately, in the majority of Companies of this class in this State, the recognition of this duty by the directors has been a part of the policy of their management; until recently it has been the policy also of the Company in Haverhill. Now, however, this policy appears to have undergone a very decided change.

In July, 1899, the Haverhill Gas Securities Company was chartered under the laws of this Commonwealth, with a capital of $500,000, and with the avowed purpose "to transact a general brokerage business, and to purchase, hold, sell, assign, transfer, mortgage, pledge or otherwise dispose of the shares of capital stock of, or any bonds, securities or evidences of indebtedness created by any other corporation or corporations of the Commonwealth of Massachusetts, and while owner of such shares of stock to exercise the rights, powers and privileges of ownership."

Subsequent events seem to indicate that in these words its real purpose was adroitly concealed. Its promoters and principal incorporators had already completed negotiations for the purchase of all the outstanding stock of the Haverhill Gas Light Company, whose par value was $75,000, and agreed to pay therefor substantially the entire capital of the Securities Company. Either with this stock or the cash collected for its purchase, in order to complete a perfunctory compliance with our laws, the entire capital of the Securities Company was paid in.

It then proceeded to issue and sell 5 per cent. debentures for the full amount of $500,000, with the entire stock of the Gas Light Company deposited with a trustee as collateral therefor, leaving to the promoters, as their profit in the transaction, the entire capital stock of the Securities Company and the control of the Gas Light Company.

We have been unable to learn that the Securities Company possesses or expects to acquire any other property or source of income in addition to the equity in the Haverhill Gas Light Company's stock and the returns from its business.

In 1868 the Legislature passed the following act, which is now a part of the Public Statutes: "No railroad corporation, telegraph or gas light company chartered under the laws of this Commonwealth shall hereafter declare any stock dividend or divide the proceeds of the sale of stock among its shareholders."

This is not merely a prohibition against stock watering, but against the division of a surplus into new capital stock. The principle announced in this statute is not to be defeated by any shrewdly contrived method of stock manipulation. The obvious purpose and tendency of the Securities Company are to evade and annul the policy which this statute declares. It is indirectly, but distinctly, an effort to capitalize the Company's surplus. To pay interest upon the new bonds will annually require a sum greater by more than 60 per cent. than the highest regular dividends ever paid by the Gas Company.

The existence of this burden is a virtual declaration of a purpose in the Securities Company practically to take out of the Gas Light Company, directly or indirectly, sooner or later, that portion of the profits which the management has been accustomed to reserve within the corporation for the joint benefit of the Company and its consumers. It has already taken by a single act the sum of $20,000, which it claims was in anticipation of a dividend not yet earned.

In view of these facts, there is no reason to believe that the former policy of the Company in the treatment of profits will be continued, but there is ample reason to assume that it will turn over to the Gas Securities Company, until its needs are satisfied, whatever provision for contingencies may be allowed in the price.

To such a policy consumers ought not to be asked to contribute.

The Board therefore recommends that the net price to be charged for gas supplied by the Haverhill Gas Light Company from and after the first day of February next shall not exceed 80 cents a thousand feet.

Relation of Coke Producers to Consumers.

[A paper read by Mr. E. M. Peters, Uniontown, Pa., before the Central Mining Institute of Western Pennsylvania.]

In order to arrive at an intelligent consideration of the relation of the producer to the consumer, it is necessary to get at least an approximate idea of the extent of the production.

The gentlemen who has just preceded me (Mr. Keighley) has given you figures as to the number of ovens now in operation and in course of erection, but these figures do not quite tell the whole story.

There are now employed in direct connection with the coking industry, in the Connellsville region, more than 20,000 persons whose daily wages exceed $30,000 and who produce 200,000 tons of coke each week. We may safely say that this means that 200,000 tons of pig iron are smelted each week, and in this operation alone 12,500 men find employment at a daily wage of more than $20,000. Follow this line

of thought to its conclusion, embracing as it does all those who are employed in steel mills, rod and plate mills, in the transportation departments of our railroads, and then think what would be the result of a complete cessation of work in this industry; hundreds of thousands of men would be thrown out of employment and millions of dollars lost. There is no other industry in the world upon which the welfare of so many persons depends. This being true, then anything that tends to the lubrication of the wheels of this industry is a benefit to mankind in general.

I think you will all agree with me when I say that the first thing the coke producer should know is what the coke consumer needs. But does he always know this, or knowing does he always act upon the knowledge he possesses?

The day of haphazard guessing as to what is necessary to produce certain results in the blast furnace has gone, never to return, and the up to-date furnace manager can figure to a certainty what results he may expect at the tapping hole if his calculations as to what is being charged into the furnace are correct. And in these latter calculations the most uncertain thing he has to contend with is his coke. His ores are carefully analyzed at the mines, at the lower lake ports, and again as they are received at the furnace, where they are kept separate and apart from each other and are changed into the furnace in exact predetermined chemical proportions. His limestone, which is the least harmful of any of the ingredients of the charge, is also analyzed. And then his coke follows.

It is too often the case that the furnacemen do not follow their coke as closely as they do their ores. Ten years ago you could have counted on the fingers of one hand the concerns who made a practice of semi-weekly analyses of their coke, and to-day you can easily count upon the fingers of one hand—and have fingers to spare—those who make a daily analysis of coke received.

The time was—and has but recently passed—when the founder laid all of his troubles to his coke, and was nearly always correct, for it was the custom, years ago, to buy coke through a middleman, or broker, who represented a large number of small operators, whose works were possibly scattered over all the Connellsville region, and sometimes outside. Coke was shipped to any consumer from any of the ovens represented, and the result may be imagined. One of the greatest blessings—although it came in disguise—was the consolidation of the small holdings under one central management and ownership, for it allowed expenses to be incurred, and researches undertaken that could not have been dreamed of by the individual operator.

Anyone familiar with the Connellsville region will know that there is a vast difference in the chemical analyses of the coke made at the various mines. I have seen analyses of coke made at different works that were considered the best in the region that showed a variation of 30 points in phosphorus, that is from .005 to .035. Variations in the same mine will frequently run as high as this. A distance of 300 feet on a flat has been known to show a difference in phosphorus of 45 points, from .009 to .054 and a difference in sulphur of 1¼ per cent.

The specifications for iron and steel are becoming more rigid every year, and it is necessary that furnace managers shall know just what their coke will analyze. You can readily see from the foregoing examples how easily a Bessemer mixture figured out with a good margin for variation, can be changed into a non-Bessemer one by changing the shipments from one plant to another.

These are points that few coke producers outside of those directly connected with furnace interests know much about. During the past few months I have frequently heard such assertions as the following made by prominent men in the coking industry:

One said to me that a matter of 1½ to 2 per cent. in sulphur was not a serious drawback to coke as it only meant a little more lime to a charge to flux it from the mixture.

Another said that all the steel works were now seeking a high phosphorus coke to change their Bessemer iron into a basic one.

You will see from such remarks as these that it is necessary for a maker to know what his customer wants. Then, in order that he may give him just what he needs, he should know what his mine is capable of producing.

Every heading should be carefully sampled as it is driven, and complete analysis made, particular attention being paid to the phosphorus and sulphur, and then the coal should be as carefully mixed as possible, in order to produce the most uniform results. I do not mean that there should be a mechanical mixture in large bins through the use of very expensive machinery, but that the men should be so distributed on the various headings as to give the desired results.

You will say that this is a great deal of trouble and expense. Well, I partially agree with you, but you must agree with me when I say that you must incur trouble and expense whenever you would succeed in producing the best results in anything.

But a few years ago the furnacemen said that chemical analyses of each cast was a very expensive undertaking, yet to day you will find but very few furnaces that do not possess their own laboratories fitted up at great expense and, in many instances, run day and night.

The next step the producer should take is to give his customer the best coke his ovens are capable of making. In times like the present the temptation is very great to charge the ovens to their very utmost capacity—and a little beyond, but I believe there are few who yield to the temptation.

May I be pardoned if I digress for a moment and say a word about the man who actually does make the coke? He is called the superintendent on the pay rolls, and pretty much everything else by other people. If you ask what are his qualifications, the pit boss will say he has none and never will acquire any; the inspector will say he is usually a man who should spend the greater part of his natural life in reading the mining law and learning the great responsibility that has been thrust upon him, for he never would have acquired it any other way; and the railroad people will tell you that he is the greatest kicker that ever lived since the days of the army mule.

I think it must have been a coke superintendent of whom the following story was told: "A man noticed that his boy seemed rather abstracted at the breakfast table and asked the cause. The boy said: 'Papa, I had a dream last night and thought I died and was taken up to heaven, and I was met at the gate by St. Peter, who took me in. But he did not take me up the golden streets as I thought he would, but he took me out into the center of a large field where a ladder stood that reached up so far that you could not see the top of it, and he told me that the only way to reach the real heaven was to take the large piece of chalk he gave me and climb the ladder, writing on each rung some sin that I had committed, and while I was thinking what I would write on the second rung I saw you coming down.' 'And what was I coming down for, my boy?' asked the father. 'That was what I asked you; and you said *for more chalk*,' said the boy."

I believe that as a rule the maker wants to give the consumer the best coke his ovens will produce. There may be exceptions, but they are so few that they only prove the rule.

Now, on the other hand, what should the producer expect from the consumer? First and foremost, that he shall know what he wants. You will say that any man should know what he needs to successfully conduct his business, but there are many furnacemen and small users of coke at foundries who do not know what they want, and when anything goes wrong with their cast will immediately lay all the trouble to the coke.

Many amusing incidents occur where coke is shipped to small plants using from two to six cars per month. Not long ago a superintendent was sent by his firm to investigate a complaint from a foundry in this city, who reported that the last car of coke sent them was "Very bad, being high in sulphur, and much of it simply rotten." The superintendent went to the foundry and was sent by the manager, who did not have time to go with him, to the cupola man, who in turn sent him to the driver, who was duly found. The matter of the quality of the car of coke was brought up, and the driver gave it as his positive opinion that it was the worst coke he had ever hauled, and he had been hauling coke for more than two years. Who could dispute such expert testimony as that?

Of course this was an exceptional case, but the average founder knows but very little as to what goes into his charge. He has been taught to judge his iron by its fractural appearance, and will not believe that it can be wrong if it shows a good grain. But this is a condition that is rapidly disappearing, for even the smallest foundries are now requiring that their iron shall be sold to them on analysis alone.

The markets of the world must be ours, and we can get them by selling cheaper than our competitors, and they can only be held by having a very superior article. In order that we shall have such an article, each and every producer who has anything to do with any of the integral parts of it must see that his parts have in them all the knowledge and skill that can be secured. I came very nearly saying "brains," but was reminded of the story of the oil firm who made many sales on the strength of the assertion that "The brains of the management went into every barrel of their oil." When times got hard and profits were low they yielded to the temptation to adulterate their mixture, which brought a letter from one of their best customers saying that "They regretted to note that the management was suffering from paresis."

The nineteenth century is upon us, with duties the country never

dreamed of, and your duty and mine is to do all we can toward helping her to hold by our products what she has so gallantly won with her guns. Let Germany growl and England glare, but our ever victorious army of trade will meet the markets of the world and conquer them as surely as Dewey at Manila, and Schley at Santiago, conquered the Spanish fleets.

A Method for the Estimation of Ferrocyanides in Old Purifying Materials.[1]

By E. DONATH and B. M. MARGOSCHES.

The estimation of ferrocyanides is an operation which has often to be done by commercial chemists engaged either in the manufacture of prussiate both by the old process from residues rich in nitrogen and potash, a process which is gradually being abandoned, and by the new process which is now being adopted, the starting point of which consists of exhausted purifying materials.

Some time ago Zulkowsky (*Dingl. Polyt. Journ*, 1883, 249, 68) described a volumetric method for estimating the return in ferrocyanide of the melted mass by the old process. There are also several methods known for the estimation of the Prussian blue in old purifying material (C. Moldenhauer and W. Leybold, *Journ. f. Gasbel.*, 1889, 155; Knublauch, *ibid.*, 1889, 450; Gasch., *ibid.*, 1889, 166; Drehschmidt, *ibid.*, 1892, 221).

Frequent analyses of old purifying material have made us endeavor to find a more rapid method, which would at the same time be as exact, for the estimation of ferrocyanides besides those already published.

The method we have devised rests on the following facts: The alkaline ferrocyanides, as well as the ferricyanides, in acid solution, energetically resist the action of oxidizing agents, even when these are fairly strong, while they are easily decomposed by the same reagents in alkaline solution. Under these conditions all the iron is separated in the form of a precipitate composed principally of ferric oxide, and is easy to estimate quantitatively.

When we place in contact a solution of potassic ferrocyanide and bromized soda, at the ordinary temperature (80 grms. of sodic hydrate is dissolved in water, and after cooling made up to 1 litre, 20 c.c. of bromine are then added while stirring vigorously) no reaction takes place; but, after prolonged heating, a thick, pulverulent heavy precipitate of a brick red color is formed, and at the same time there is a lively disengagement of gas.

Qualitative analyses have shown that in this reaction the ferrocyanide is first transformed into ferricyanide, and this latter, being submitted in its turn to oxidation, is decomposed in the manner just described. The reaction therefore has two phases. On leaving the precipitate formed to stand for some hours, then filtering and washing it, the iron can be estimated by any well known method, and the proportion of ferrocyanide present calculated. It suffices to multiply the weight of the iron found by 7.5476 to get the amount of the crystallized salt $K_2FeCy6+3H_2O$, or by 6.5833 for the anhydrous salt.

The iron in this precipitate may be estimated by several different methods.

The precipitate can be dissolved on the filter by means of dilute warm hydrochloric acid, and the iron precipitated in the hydrochloric solution by ammonia. We can also dry the precipitate on the filter; put as much of the precipitate as possible into a small flask, incinerate the filter, decompose the small quantity of ferric oxide with bisulphate of potassium, add it to the rest of the precipitate, and dissolve the whole in dilute sulphuric acid. It must then be reduced by zinc and titrated with permanganate.

The analyses made by us gave very concordant results. Supposing the product obtained contained 99.6 per cent. of crystallized potassic ferrocyanide, the results we obtained by this process were from 0.2 to 0.4 per cent. too low.

The bromized soda, as an oxidizing agent, can be replaced by permanganate of potash in alkaline solution. When we submit a solution of potassic ferrocyanide and an alkaline solution of permanganate of potash to the action of heat, the latter body is rapidly reduced under these conditions; there is evidently formed a precipitate of hydrated peroxide of manganese, besides the precipitate referred to above, and containing a quantity of ferric oxide corresponding to the potassic ferrocyanide present. By continuing the addition of the permanganate until the red tint remains constant, and adding dilute hydrochloric acid and heating, this precipitate, as well as the excess of permanganate, is decomposed and chlorine given off. It suffices to drive off the chlorine by heat, to separate the iron from the manganese by the acetate method, in the sufficiently diluted solution, to wash and calcine the precipitate of manganiferous basic ferric acetate, and to estimate volumetrically by permanganate the quantity of iron present.

In every case the use of bromized soda is preferable, in spite of its higher price, as its action is much more rapid.

To apply the process just described to old purifying material, the following is the best manner of proceeding: Old purifying material contains, besides ferrocyanides, sulphur and a considerable amount of non-volatile tarry products. To estimate the Prussian blue, or rather the ferrocyanides, the material should be finely powdered, and treated at a gentle heat with an excess of caustic potash at about 15 per cent, with a view to completely transforming the Prussian blue into ferric hydrate and ferrocyanide of potassium. After dilution, the alkaline liquid obtained is filtered and the residue washed, after having been treated on the filter with a small quantity of dilute potash lye, until the whole of the ferrocyanide has disappeared.

However, we eventually discontinued the use of this somewhat complicated and tedious method of decomposition, and adopted the method given by Dr. Moldenhauer and W. Leybold (*Journ. f. Gasbel*, 1889, p. 157).

The spent material is rapidly ground up in an iron mortar, well mixed, and 50 grms. is taken for the analysis. This sample is placed in a flask of 1 litre capacity, and moistened with 100 to 150 c.c. of caustic potash at 15 per cent. The flask is then left for some time in a warm place, and frequently shaken; it is then filled up to 1030 c.c., as the results obtained by the above mentioned chemists show that the residue of 50 grms. of material occupies a volume of 30 c.c. The liquid is transferred to a larger flask, well mixed, and filtered through a folded filter paper. The potassic ferrocyanide is estimated in an aliquot part of the filtrate, the color of which varies from brownish yellow to reddish brown by the method already described. We recommend, by preference, the volumetric estimation of the iron in sulphuric solution by permanganate, after reduction to the ferrous state.

More exact results can be obtained by exhausting the material by means of sulphide of carbon, with the object of eliminating the sulphur and the greater part of the tarry products, previous to proceeding in the manner just described.

The analysis, by our method, of a particularly rich sample of an old purifying material, gave us the following results, calculated as crystallized ferrocyanide of potassium, 14.3, 14.54, 14 51, and 14 65 per cent.; another method gave 14.48 per cent.

Although we have not had the opportunity of applying our method of analysis to the estimation of the ferrocyanides in the melted mass of the old process, we have no doubt but that, in this case also, this method would give entirely satisfactory results.

We may further mention that our method is not confined to the estimation of the ferrocyanide corresponding to Prussian blue, but it may also be used in connection with the ferrocyanides corresponding to the other hydroferrocyanic compounds which may be met with in all purifying material.

1. *Zeitschrift fur Angewandte Chemie.*

Quicksand.

Engineering Record says that the nature of quicksand was discussed at a meeting of the American Society of Civil Engineering on February 7, when a valuable paper on the troublesome Jordan level of the Erie Canal, by Mr. William B. Landreth, was presented. Mr. Edward P. North said he had never seen quicksand which did not contain clay. He had taken quicksand, stirred it in water, dried it and then made it into a cohesive ball which he believed contained from 15 to 20 per cent. of clay. Mr. James Owen considered ordinary sharp-cornered sand comparable to a pile of loose rock, and quicksand, with its rounded grains, comparable to a pile of cobble stones. Mr. J. G. Tait said that ordinarily almost any sand would flow and be troublesome under a foot or more head of water. Contractors are usually prone to call it quicksand, but if it does not contain clay it can be pumped dry and handled without great trouble. If it contains clay, it retains the water so long that it is very difficult to drain it. Mr. George Hill said that the foundations of the Mail & Express Building, New York, exert a pressure of 3½ tons per square foot on very fine micaceous sand and have settled about ⅛ inch. The foundations of the Western Union Building are on similar sand and are loaded to 3¾ tons per square foot. After the building was finished, pumping in some adjacent wells caused the walls to settle, but the settlement ceased when the pumping was stopped. The foundations of the Prince Building, loaded to 6 tons per square foot, are on mixed sand and gravel 6 inches below the ground water line. The water has no means of egress, and no settlement has taken place. Foundation pits 6 feet square were carried 5 feet below water line in the Exchange Court Building. The fine

micaceous sand caused considerable difficulty by coming through the sheet piling, and nearly a cubic yard of it would rise in the bottom of the pit over night. He defined quicksand as sand with sufficient moisture to cause it to flow when excavations are carried below water level. Mr. Samuel Whinery described a case where a railroad cut was made in what appeared to be a pocket of quicksand, which compelled the contractor to abandon the work. Subsequently the pocket was drained by ordinary railroad ditches, and no trouble was found in making the excavation with one to one slopes, which are still standing.

A carefully prepared discussion was read by Mr. Allen Hazen, in which the subject was considered from a different point of view. His idea of quicksand is an even-grained sand, containing for the time more water than would normally be contained in its voids, and therefore with its grains held a little distance apart, so that they flow upon each other readily. The sand may be either coarse or fine; generally it is extremely fine and contains no clay. It may be that some materials contain a little clay and still act as quicksand; but if so, they act as quicksand notwithstanding the clay, and not because of it. A material containing clay particles in considerable quantity is cohesive and impervious. Water may press it out of shape, make cracks in it, and rush through it. Under some conditions the whole mass may flow slowly under heavy pressure like molasses, but it will never make an intimate mixture with water capable of flowing through small openings, and behaving much like water, which is the characteristic property of quicksand.

The sand in a mechanical filter is a good illustration of quicksand. The sand is placed in a tub, with screens or other drainage apparatus at the bottom. When the current is downward, the sand is firm, and it remains firm after it is drained. When the sand is washed by an upward current it is lifted by the water and occupies perhaps 10 per cent. more volume than it did with the downward current. In this condition it is suspended in the water, and is so soft that a stick can be pushed into it with but little more resistance than would be offered by as much water. As the voids in the sand are increased the friction is greatly reduced, until a point is reached where the friction just balances the excess of weight of the sand over water, and this condition may be maintained indefinitely, the upward current of water just sufficing to hold the sand in a state of suspension. In this condition it is ideal quicksand. The phenomenon is precisely the same whether the sand is of wind-worn spherical grains or of the most angular grains of crushed quartz.

The upward velocity required to lift a sand in this way is a direct function of the size of the sand grains, and can be computed. The sand used in mechanical filters has an effective size of from 0.40 to 0.60 millimeter, and the velocity used in washing is such that the friction is more than equal to the excess in weight of the sand over water, but is not three times as great. If it were, some of the sand would be carried away. The following table shows the computed velocities at which the friction equals the excess in weight of sands of various grain sizes, or, in other words, the velocities at which the sands will just be lifted.

Computed Velocities Required to Lift Sands of Various Grain Sizes at a Temperature of 5 Deg. Fahr.

Effective Size of Sand.	Velocity of Solid Column of Water.	Velocity of Solid Column of Water.
0.50 millimeter.	250 meters per 24 hrs.	410 in. per hr.
0.40 "	160 "	262 "
0.30 "	90 "	148 "
0.20 "	40 "	65 "
0.10 "	10 "	16 "
0.05 "	2.5 "	4 "
0.03 "	0.9 "	1.5 "

This table perhaps gives an indication of the reason why quicksands are usually fine sands. The finest mortar sand has an effective size of from 0.20 to 0.30 millimeter. To lift it requires an upward velocity of from 5 to 12 feet per hour, a velocity greater than those which generally occur in the ground water about excavations. With sand 0.10 millimeter in diameter only 16 inches per hour are required to lift it, a velocity which is probably quite common; while the lower velocities of 4 and 1.5 inches per hour, required to lift sand with effective sizes of 0.05 and 0.03 millimeter respectively, are almost sure to exist where excavations are made below the ground water level in pervious materials; and where sands of these sizes exist they are almost sure to act as quicksands.

There is a condition which would make a quicksand, which at first sight would seem to be different from that mentioned above, but which in reality is but a variation of it. It is when sand in apparent equilibrium is made quick by a sudden shock or blow. For example, assume a layer of sand with an effective size of 0.05 millimeter and 3 feet deep, in which the voids are 42 per cent., entirely filled with water. The grains are in a not very stable equilibrium and this sand is capable of being compacted to 40 per cent. of voids. A smart blow or sudden pressure will disturb the equilibrium and the sand will be suspended by the water which it contains. It will shrink 5 per cent. in going from 42 to 40 per cent. of voids; and under the conditions assumed, if perfectly drained at the bottom, half an hour will be required for the excess of water to drain out of it. During this time it will be quicksand. This phenomenon may be seen on many lake shores where the sand is held full of water by capillarity, but in this case the sand is usually coarser, and the length of time that it remains quick is but a small fraction of the above, perhaps only a minute or two, or even less.

A number of samples of material, labeled mixtures of clay and sand, were given to Mr. Hazen by Mr. North. Under the microscope these proved to be entirely free from clay, and consist of particles from 0.03 to 0.10 millimeter in diameter, with an effective size of approximately 0.04 millimeter. Ninety per cent. or more will pass a sieve with 200 meshes per lineal inch. These materials contain a little lime, which, in Mr. Hazen's opinion, rather tends to keep them from acting as quicksand than otherwise. The question may be raised as to the propriety of extending the name of sand to these extremely fine materials. They occur quite freely in nature, in which the particles are mostly silica, occasionally with a mixture of hard silicates. Under the microscope they appear precisely like sand. The particles are angular, the arrangement of the particles and the percentage of voids are substantially the same as with coarse sands. The relation of these materials to ordinary sand is much the same as that of sand to gravel; but it is not correct to speak of sand as fine gravel, and it may not be correct to speak of these materials as fine sand. Clay is an entirely different substance. Mr. H. W. Wiley, chemist of the United States Department of Agriculture, has made the following statement in regard to the properties of clay. "The percentage of pure clay is about 75 per cent. in natural clays, 45 in heavy clay soils, and 15 in ordinary loamy soils. When freshly precipitated by brine it is gelatinous, resembling a mixed precipitate of iron and aluminum oxides. Its volume greatly contracts on drying, clinging tenaciously to the filter, from which it may be freed by moistening. On drying it becomes hard, infriable and often resonant. It usually possesses a dark brown tint, due to iron oxides. Under the action of water it swells up like glue, the more slowly as the percentage of iron is greater. In the dry state it adheres to the tongue with great tenacity. According to Whitney the finest particles of colloidal clay have a diameter of 0.0001 millimeter. With a magnifying power of 350 diameters, however, Hilgard states that no particles can be discerned." The clay particles are tens if not hundreds of times smaller than the smallest sand grains here considered, and differ from them both physically and chemically.

The Diesel Oil Engine.[1]

Among the various oil engines which have lately been introduced in Germany, few have excited so much theoretical interest as the Diesel. The inventor has been studying the subject of the utilization of heat in gas and oil engines for about 15 years, and has embodied the fruit of his researches in a small book entitled "Theory and Construction of a Rational Heat Motor" (J. Springer, Berlin, 1893), an English translation of which has been published in London by Messrs. Spon. In this volume Herr Diesel lays down the principles which have guided him in his studies, and which have given rise to what he terms a new theory of combustion. Starting from the proposition that steam, gas, and air engines are worked upon a defective principle, and that no improvement in them will produce better results, as long as this principle is retained, he proceeds to formulate the theory and conditions he wishes to substitute for them. A distinguishing feature of his engine is that it is based upon a new theory, and the details of construction are not, as is often the case, first laid down, and the theory worked out from them.

The relatively low heat efficiency of steam engines, even when driven with superheated steam, is well known. This is chiefly traceable to the nature of steam, the loss of heat in the boiler during generation being 20 to 30 per cent. The small theoretical heat efficiency of a steam engine, the sensitiveness of steam to changes of temperature, and its tendency to condense against the walls of cylinders, must also be taken into account. For these reasons Herr Diesel is of opinion that this cycle cannot be much further improved, and that increase of efficiency in power engines must be obtained by changing the method of treating the combustible. A greater range of temperature in the motor cylinder is also desirable. Since there are physical limits to this temperature in one direction, it must, to give the maximum range, be raised in the other, either by increasing the pressure, or by combustion in the cylinder itself. Both these methods have been adopted in the later types of gas and oil engines; the chief novelty in the Diesel is that combustion is regulated according to a system different to that usually employed.

After examining the methods of work in the cylinder of an internal

1. From *Engineering*.

combustion engine, Herr Diesel formulated the following principles, which ought, in his opinion, to govern such engines to obtain the maximum heat efficiency. His propositions are based upon the pure Carnot cycle, which many of the best German authorities think is better realized in the Diesel than in any other heat engine. To construct a motor in which all the heat generated by combustion shall be converted into work is impossible, but the Diesel approximates more nearly to this ideal efficiency than has hitherto been found practicable. As is well known, the heat losses in a good gas or oil engine are large, between 75 per cent. and 80 per cent. or a heat efficiency of 20 per cent. to 25 per cent.; and if an attempt be made to diminish the loss to the cold walls, or to the cooling jacket, an increased loss to the exhaust is the result and no practical gain is obtained. It was first proposed to reduce these losses by isothermal combustion, or combustion at constant temperature instead of at constant volume or pressure. This was secured by introducing a small quantity of combustible gradually into a volume of compressed and highly heated air, where it kindles spontaneously. The piston is forced out at the same time in such a way that no increase of temperature takes place, because the heat developed by each particle of combustible is instantly absorbed by the cooling due to expansion. Any improvements in the cycle of work in an internal combustion engine should, in Diesel's opinion, be carried out in this direction.

To effect them, he laid down some years ago the following fundamental conditions for combustion:

1. Production of the highest temperature of the cycle, not by and during combustion, but before and independently of it, entirely by mechanical compression of the air.

2. Gradual introduction of a small and carefully regulated quantity of finely divided combustible into the highly compressed and heated air, in such a way that no increase of temperature takes place during the motor stroke, but all the heat generated is at once carried off by the expansion of the gases of combustion. (The combustible, he says, may be gaseous liquid, or powdered coal, but up to now only oil has been used).

3. Introduction of a large quantity of air in excess, instead of admitting only as much air as is required to obtain proper combustion of the fuel in the cylinder.

Originally there were two other conditions, which have been relinquished for the present. The air was to be compressed, first isothermally, water being injected to carry off the heat, then adiabatically, thus embodying the Carnot cycle. This method involved such enormous pressures of from 100 to 250 atmospheres that it was abandoned, and adiabatic compression only, from 30 to 50 atmospheres, was adopted. The modification is based upon a theoretical diagram, in which the two extreme points, that of the maximum pressure of combustion, and the minimum pressure (expansion to exhaust), are cut off. There is practically no diminution in the area of work, the construction of the cylinder is made simpler, and a working, instead of an unworkable, cycle is obtained. Further, the second condition for combustion was to be so carried out that no water jacket was required, but it was found that to work without one necessitated much larger dimensions of the cylinder, and for practical reasons a water jacket is now always used. The fundamental idea, on which the whole scheme of the motor rests, is that the number of heat units, or quantities of heat, contained in oil or other combustible, are too great to be utilized in an engine cylinder without a large excess of air—say 100 per cent.—to absorb them. Since, however, in all processes to obtain power from heat, a certain portion must be sacrificed, the heat efficiency can never equal unity. Therefore, a water jacket is not an evil, or the main cause of the waste of heat in an engine, as it is generally supposed to be. If the heat carried off by it be kept within certain limits and carefully regulated, it forms an auxiliary like the condenser of a steam engine, besides being theoretically necessary. Moreover, combustion should not be left to itself, but by a suitable arrangement of valves, etc., be adjusted throughout the motor stroke, to maintain the right proportions between temperatures, pressures and volumes.

Apart from theory, the Diesel engine fulfills one of the principles upon which all the latest writers on internal combustion motors insist, namely, that the best way to improve the heat efficiency is to increase compression. This seems at present to be the last word of science on this subject, but to carry it out in practice is not easy. Even pressures of air of 30 to 40 atmospheres, to which Herr Diesel was obliged for some time to confine himself, were high enough to cause great practical difficulties, and required careful designing. Probably the small but important details of valves, joints, etc., in making which skilled labor is essential, have contributed to retard the appearance of the engine in the market; and even now, few appear to be sold in Germany. Critics prophesied that these high pressures and the negative work involved, would impair the mechanical efficiency, and counterbalance the gain from the improved cycle, and a lower instead of a higher heat utilization per brake horse power would be realized. As will be seen from the results of the trials, these forebodings have not been justified, and the theoretical advantages anticipated were so important that Herr Diesel was urged to continue his efforts. At first he proposed to use powdered coal, but the difficulties were so great that the scheme, however fascinating, was abandoned. Hitherto the engine has only been made to work with oil, a small quantity of which is injected in a liquid state into the compressed and heated air, and instantly vaporized. Experiments are, however, in progress with lighting gas, and cheap or power gas.

As originally designed, the engine was vertical, inverted, having 3 cylinders side by side, all unjacketed, the two smaller of equal diameter single acting, and the central of larger diameter double acting. The ordinary 4-cycle was used. The two outer cylinders carried plunger pistons, and air already compressed in the central cylinder was sent on to them, and further compressed during the upstroke. The combustible was then supposed to be injected alternately into the tops of these smaller cylinders; combustion and partial expansion took place during the down motor stroke, and the charge passed to the larger central cylinder, where it was completely expanded and discharged to atmosphere. The cycle of operations was thus divided between three cylinders, the initial compression of the air and the final expansion of the charge taking place in the central. There were 8 valves driven from a horizontal valve shaft, and each piston worked on to a separate crank, the 3 cranks being 180° apart. The large excess of air introduced into the cylinders was supposed to absorb the heat and obviate the necessity for a water jacket. It was intended to attain pressures of 250 atmospheres, and never to allow the temperature in the cylinders to exceed 800° C. The heat generated by combustion being instantly carried off by expansion, only that produced by compression of the air affected the cycle.

So complicated a working method was only possible in theory. The engine does not appear to have been constructed and a modified cycle of combustion was soon introduced. For small powers (and hitherto the Diesel oil engine has only been made for such), one cylinder only is used, in which all the operations are completed in two revolutions, or one motor stroke in four, as in most other gas and oil engines. Even thus it was found that the three main conditions of combustion could not be strictly realized. The curve of combustion is not perfectly isothermal, and a slight increase of temperature or pressure is usually produced, but these differences do not affect the principles on which the cycle is based.

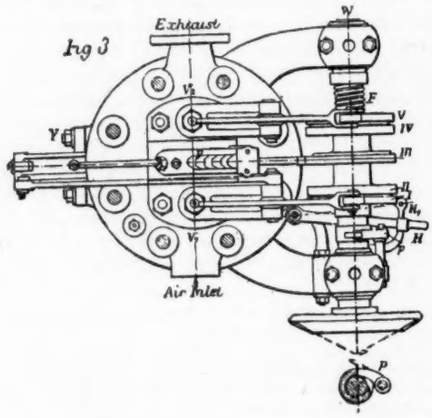
Diesel has been strongly attacked by Herr Capitaine, who, in a recent article in the "Zeitschrift des Vereines Deutscher Ingenieure," maintained that his own patent had been infringed, and denied that there was anything new in the Diesel heat motor. It is certainly true that many writers, including Herr Capitaine, have strongly advocated the use of higher compression, and have proposed to regulate the process of combustion by mechanical means. The fact, however, remains that Diesel was the first to produce a working engine based on these principles, and in which compressions more than double those used in other motors have been attained. He also succeeded in making his engine work without external lamp or flame of any kind, not even at starting. He appears to have made good his claim to produce a motor in which the temperature required for combustion is obtained wholly by compression of air. The injection of a minute quantity of oil is then sufficient to cause ignition of the charge. Thus he has been the first to combine the requisites for perfect combustion, and carry them out on a practical scale.

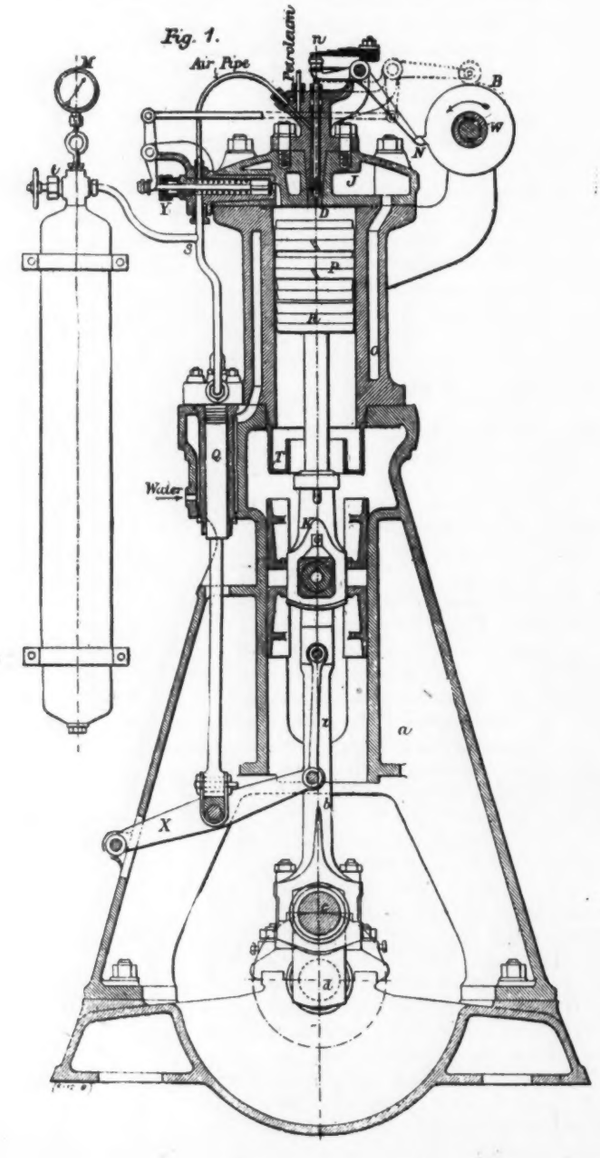
Scientific men in Germany, especially Professors Linde, Zeuner, Schroeter, Slaby, and others perceived that the theoretical advantages of the Diesel motor were so great that to embody them in a working engine was worth much effort. The first to take up the invention were the largest engineering firm in South Germany—the Machinen Fabrik Augsburg, and Messrs. Krupp, of Essen. The right to manufacture has also been acquired by Sulzer Brothers, of Winterthur, and MM. Carel, of Ghent. With this array of first class names, both theoretical and practical, we might expect by this time to find fairly cheap engines in the market, sold in some number, but we are bound to state that such has not hitherto been the case.

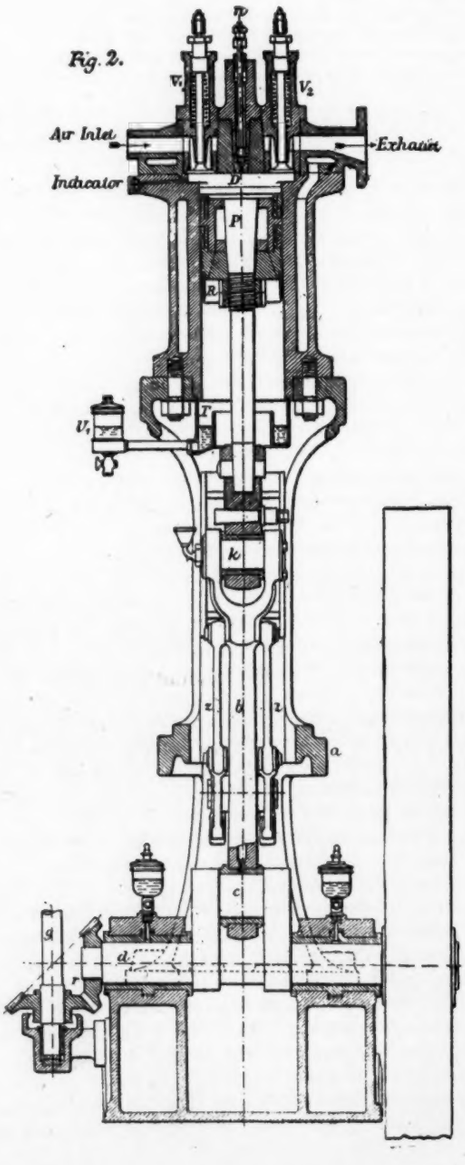
It was determined to construct a single cylinder 12-horse power engine as being simpler in detail than the compound type, and to use petroleum only as the working medium. This experimental engine consisted of a single acting vertical cylinder with plunger piston work-

ing downwards on to the crank, and especially adapted for the high pressures required. The valve shaft placed at the top of the cylinder was worked from the motor shaft by conical gearing two to one, and carried three cams opening the air, petroleum and exhaust valves. The piston drew in air only during its down stroke; the air valve was then released by the cam and closed by a spring, and the air compressed by the up stroke till its temperature was raised to the required ignition point. The piston then descended (motor stroke), the oil being injected during the first part of the stroke by a small pump worked from the valve shaft. The latter carried three cams, and according to the one brought into play, the oil was admitted during either 2½, 5, or 10 per cent. of the stroke. The period of admission was thus definitely regulated, and gradual combustion concurrently with admission is said to have been obtained. The supply of oil was then cut off, the air expanded till the lower dead point was reached, and the next up stroke discharged the products of combustion. The engine was started by a special valve from a reservoir of compressed air previously filled while running. According to Herr Diesel, it worked at first without a cooling jacket. Great difficulties were experienced on account of the extremely high pressures, and each detail had to be separately studied. The accurate admission of so small a quantity of oil at a given moment was also not easy, and two years were spent in tentative efforts. By the end of 1895, the results justified the expectations of the inventor.

In 1897 this experimental engine was replaced by a 20 horse power oil motor, in which the previous construction was modified, chiefly by the addition of a water jacket and air reservoir. This engine, shown in Figs. 1, 2, and 3, taken from the "Zeitschrift des Vereines Deutscher Ingenieure," is also vertical, and a piston with rings has been substituted for the plunger. A small air pump, worked direct from the connecting rod, compresses air at a pressure above that in the cylinder into a receiver at the side, connected to the admission valve in which the same high pressure is maintained. The oil injected into this valve by a small pump is brought into immediate contact with the air at high pressure, and thoroughly broken up. In the engravings d is the crankshaft, P the piston and C the water jacket, Q the air pump worked by levers z and X from the connecting rod to fill the reservoir L with compressed air. S is the pipe equalizing the pressure between the air pump, the reservoir, and the admission valve chamber D at the top of







the cylinder. *B* is the valve shaft worked by gearing from the crank-shaft and driving the admission valve *V1* for the compressed air, the exhaust *V2* and the oil pump (not shown) which sends the oil on to the injecting nozzle *n* and to the admission and mixing chamber *D*. The engraving shows the method of maintaining an equilibrium of pressure in this valve chamber. The curve of combustion can be regulated by varying either the time or the point in the stroke at which the oil is injected, or the pressure in the air receiver. The valve shaft carries five cams, under normal conditions three are used, actuating valves *V1*, *V2* and the injection *n*. To start the engine, a lever directly connects the cylinder to the reservoir of air, the ordinary cams are thrown out of gear, and two others brought into play. As soon as the engine is started, the moving of a small rod throws out these auxiliary cams, and shifts all into their regular places.

The governing is very simple. The pump draws oil from a receiver, and sends it on under pressure to the injection nozzle. Here there are two valves, the ordinary admission and an overflow valve. As long as the latter, which is open to the air, is free, all the oil pumped is returned to the receiver. As the pump piston descends, it carries with it a ram closing the overflow valve, and the oil is then forced to flow to the nozzle. The quantity passing to the cylinder is regulated by the descent of the ram, and this depends on the position of a horizontal wedge, connected to the governor, which is interposed by the latter between the ram and the overflow valve, more or less according to the speed.

In Diesel's original paper ("Zeitschrift des Vereines Deutscher Ingenieure," July 10 and 17, 1897) an interesting series of indicator diagrams will be found, obtained during the gradual evolution of the engine. It was worked with benzine, ordinary oil, lighting gas, and various explosive mixtures, and six periods are distinguished, each marked by successive improvements in the combustion. These diagrams give evidence of the great care with which the engine has been designed and the various modifications made in its construction, the theory remaining the same. The best are, of course, the last, taken during repeated tests by German and French engineers and scientific men.

Herr Diesel claims a theoretical heat efficiency of 50 per cent. for his single cylinder engine, and 70 per cent. for the compound type, which he considers as representing better his theory of combustion. The heat efficiency of good gas and oil engines varies usually from 15 to 25 per cent. From 31 to 40 per cent. of the heat actually received is converted into indicated work in the Diesel, and the mechanical efficiency is 71 to 75 per cent., making the brake heat efficiency 26.6 per cent. The consumption, even at this early stage in its development, is said to be lower than that of any other oil motor, as shown by an interesting diagram, in which the consumption of oil in the different engines, tested at full and half load by Professor Hartman, at Berlin, in 1894, is plotted. For the Diesel the consumption increases less with diminution of the load than for any other motor, because the increase in thermal efficiency counterbalances the loss in mechanical efficiency. Since an engine is seldom worked at its maximum power this is an advantage, especially with frequent changes of load. The duty of the engine varies with the length of time during which the oil is admitted. It is very sensitive to the governor, and missfires are impossible, since there is neither ignition tube nor lamp. The engine is very easily started with compressed air as the writer has had opportunities of seeing, and after a few revolutions oil is admitted. Combustion is said to be so complete that the interior of the cylinder is perfectly clean, and the exhaust without smell. The construction is simplified by the absence of a lamp, electric ignition, vaporizer, pulverizer, or mixer. The consumption of oil does not, as in other engines, vary greatly according to the power developed. Experiments have already been made with lighting gas, and at Augsburg a 150 horse power engine driven with power gas is in course of construction. Professor Schroeter, of Munich, confirms the views of the inventor. From the first, he says, he was convinced that the theoretical principles on which the engine was based were sound, while his tests at Augsburg, in February, 1897, on the 20 horse power engine, leave no doubt that these principles have been satisfactorily carried out in practice. During the trials the indicated and brake horse power, consumption of oil, amount and temperature of the cooling water, and temperature of the exhaust, were determined. The composition of the oil, analysis of the exhaust gases, and heating value of the oil were also taken. The indicator diagrams were found to cover each other with the same regularity as in a steam engine. Four trials were made, two at full and two at half power, the speed being varied by means of the governor. The diameter of the motor piston was 9.8 inches, stroke 15.7 inches; diameter of the air pump, 2.7 inches, stroke 7.8 inches. The mean heating value of the oil used was 18,370 British thermal units per pound, and each trial lasted one hour. The annexed Table gives the results of the trial.

A consumption of ½ pound oil per brake horse power per hour is a striking result, as is also the fact that it only increased 15 per cent. when the engine ran at half load, and was relatively lower when running empty. The heat balance of the engine during the above two full power trials was as follows:

Tests of 20-Horse Power Diesel Oil Engine.—Number of Tests.	Full Power. I.	II.	Half Power III.	IV.
Number of revolutions per minute...	171.8	154.2	154.0	158.0
Metric indicated horse power (motor cylinder only).....	27.85	24.77	17.71	17.72
Metric brake horse power (motor cylinder only).....	19.87	17.82	9.58	9.84
Mechanical efficiency, per cent	74.8	75.5	57.8	59.6
Consumption of oil per indicated horse power per hour, pound.....	0.40	0.39	0.61	0.61
Consumption of oil per brake horse power per hour, pound.....	0.54	0.52	0.61	0.60
Temperature of exhaust gases deg. C.	404	378	260	260
Piston speed, per minute.....	450	400	400	410

Heat Balance.	1 Per Cent.	2 Per Cent.
Percentage of heat in the oil turned into indicated work	33.7	34.7
Percentage of heat in oil lost to cooling jacket water	39.0	40.3
Percentage of heat in oil lost in other ways.....	27.3	25.0
	100.0	100.0
Percentage of heat in oil turned into work on the brake.....	25.2	26.2

The power indicated and brake efficiency during the first trial are attributed to the greater speed. The mean of the four trials, two at full and two at half power, work out as follows:

Full Power. Both Trials Per Cent.	
Heat turned into indicated work	34.2
Heat turned into actual work on the brake.....	25.7
Half Power. Both Trials Per Cent.	
Heat turned into indicated work	38.5
Heat turned into actual work on the brake.....	22.4

These results have, we believe, not been equalled by any other engine.

The gases of combustion analyzed in the usual way gave by volume and at full power 9.96 per cent. CO_2; 4.70 per cent. O; 0.20 per cent. CO; 85.14 per cent. N. At half load there was no trace of CO. From the percentage of nitrogen the excess of air was calculated by Professor Schroeter according to the following formula:

$$\text{Excess of air} = \frac{N}{N - \frac{79}{21}} O = \text{means excess of air at full power, 26 per cent.}$$

$$\text{Excess of air} = \frac{N}{N - \frac{79}{21}} O = \text{means excess of air at half power, 160 per cent.}$$

Pounds of air theoretically required for complete combustion, calculated from the chemical composition of the petroleum = 14.78 pounds per pound of oil.

According to Herr Meyer, the Diesel engine marks the highest point to which pressures can be carried with our present methods of construction. The high heat efficiency obtained is due, in his opinion, not to combustion at constant temperature, but to the separate compression of the air and oil, so that the maximum pressure has already been reached when combustion begins, and it proceeds at constant pressure. He considers that the very large excess of air, by reducing the maximum temperature, diminishes loss to the water jacket. The minute quantity of oil injected into this highly heated air is instantly burnt before it has time to reach and be condensed against the cylinder walls. Hence the small consumption in Schroeter's trials, corresponding to the minimum in gas engines. In all other petroleum motors, owing chiefly to condensation of the oil in the cylinder, the heat expended is greatly in excess of what the corresponding amount in a gas engine would be.

The first public appearance of the Diesel oil engine was at the Munich Exhibition in 1898, when the following German firms exhibited engines: The Machinen Fabrik Augsburg, the pioneers in the construction of the motor, showed a 30 brake horse power single cylinder oil engine, driving a pump; Krupp, of Essen, exhibited a 35 brake horse power engine working a rotary pump; the Maschinenbau Gesellschaft Nuernberg, a 20 brake horse power experimental engine, while the Gas Motoren Fabrik Deutz showed a 20 brake horse power engine working

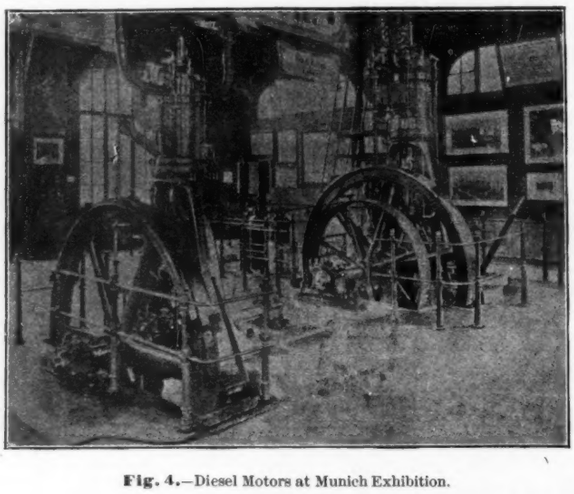


Fig. 4.—Diesel Motors at Munich Exhibition.

a Linde cold producing plant. Fig. 4 is a view of two of these engines. The writer, who saw them all at work, thought them very well made, but expensive. They were a single cylinder driven with ordinary oil, and of the type shown in Figs. 1 to 3, with a few small modifications. The positions of the governor and oil pump vary, some engines having them below on the bedplate, while the Augsburg firm places the governor above the horizontal valve shaft. If the engine has no work on, it is easily and quickly started, but if the load is thrown on before starting, a second air receiver is required, that the whole supply of compressed air may not be exhausted during the first few revolutions. A two cylinder 40 horse power engine has lately been built by the Maschinen Fabrik Augsburg.

The engine is constructed for Great Britain by Messrs. Mirrlees, Watson and Yaryan, limited, and a Company for France also exists. An engine made by the Glasgow firm has a cylinder diameter of 10 inches with 16-inch stroke, and runs at a speed of 212 revolutions per minute. It developed 24 75 brake horse power during the trial, and consumed 0.47 pounds of Royal Daylight oil per brake horse power per hour. Thus the heat efficiency, taking the indicated horse power, was 35 per cent., mechanical efficiency 71.4 per cent. These particulars of the first engine at work in Great Britain have been communicated by Messrs. Mirrlees. The latest indicator diagrams mark the gradual fall in pressure to which the practically noiseless working of the engine is due. The fact has been noted by more than one expert that the motors exhibited at Munich ran so smoothly with full work on that it was scarcely possible to realize what great forces were at work.

As regards the method of treating the oil, the following conditions are, in Herr Diesel's opinion, necessary for the best efficiency. The liquid petroleum must not be previously evaporated, and thus separated into its heavy and volatile constituents; it must not come into contact with the cold walls of the combustion space, nor should it be previously mixed with the cold air for combustion. If, when thus treated, the charge be ignited, the speed of propagation of the flame will depend upon the method of mixing the air and oil, the heating value of the latter, and the temperature and pressure at the moment of ignition. This ought not to be the case. The process of combustion should, as far as possible, be independent of the speed of propagation of the flame, and the pressure should be raised to a maximum before ignition begins, because a high pressure drives the molecules together, forces them through the air and facilitates the chemical combinations. In the Diesel engine it is said that: (a) The combustible is injected into, and thoroughly mixed with, the air; (b) the air is previously heated by compression, and thus well prepared to receive the combustible, and the process of combustion depends only on the method of admission; (c) the combustible is not previously treated; all the particles, heavy and volatile, burn instantly, and, therefore, any kind of raw oil or liquid combustible may be used; (d) the oil has not time to come in contact with, and be condensed against, the cooler walls of the cylinder; (e) the combustible is not previously mixed with air and thus cooled; (f) the process of combustion is entirely independent of the speed of propagation of the flame, because each particle of oil admitted to the cylinder finds sufficient air for its combustion. The heating value of the combustible, size of compression space and speed of piston do not affect the combustion; (g) lastly, the maximum pressure of the cycle is reached previous to combustion.

Many different oils, of densities varying from 0.79 to 0.96, such as benzine, ordinary lamp oil, American naphtha, raw heavy petroleum, and light spirit, have been tested in this engine, and yielded satisfactory results. Experiments have been made by Professor Sauvage, of Paris, at Augsburg, on the 20 horse power engine described above, with results practically the same as those obtained by Professor Shroeter. The heating value of the oil was 18,360 British thermal units per pound; consumption per brake horse power hour in two full power trials, 0.53 pound and 0.59 pound, and the heat efficiency, taking the brake horse power, from 21 to 25 per cent. It will be noted that these results are yielded by an engine which has, perhaps, not yet reached its full development, and under average conditions, and not, as in many other trials, when worked at its maximum power. The latest tests give a consumption of 0.47 pound oil per brake horse power hour, corresponding to the heat efficiency, taking the brake horse power, of more than 30 per cent. In a 30-horse power engine lately made by the Augsburg firm, the consumption has been reduced to 0.43 pound oil per brake horse power hour.

The Diesel is the most economical oil motor yet made, with very high compression and without tube or electric ignition, and it is well worth studying, especially by younger engineers. Whether it is a success commercially, as shown by the number sold in Germany, France and elsewhere, is another question difficult to decide at present. The writer in a recent visit to Germany found that not many appear to have been sold. This is probably owing to their relatively high price as compared with other oil engines, but the latter are not so economical in working, and give a lower heat efficiency.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

At the annual meeting of the Gas Company of West Chester, Pa., the officers elected were: Directors, C. Y. Audenried, Henry V. Massey, George Henderson, D. S. Lindsay and Robert Wetherill; President, D. S. Lindsay; Treasurer and Secretary, George Henderson; Superintendent, R. H. Dutton.

The proprietors of the Beverly (Mass.) Gas and Electric Company have applied for the right to extend its business of lighting and heating into the outlying towns of Manchester, Hamilton and Wenham.

Mr. George H. Norman, who was born in Newport, R. I., May 24, 1826, and who was widely known some years ago as a constructor of gas and water works plants, died at Palm Beach, Fla., the 4th inst.

The shareholders of the Wilmington (N. C.) Gas Light Company have authorized an issue of $125,000 first mortgage, 5 per cent. bonds. The stock will be decreased, and the major portion of receipts on bond account will be expended in enlarging and improving the Company's gas and electric plants.

Messrs. I. A. Kelsey, R. A. Batencourt, W. G. Bushnell and S. C. Morehouse, of New Haven, Conn., have formed a Company, under the laws of New Jersey, for the constructing and operating of a gas and electric light plant and a water works for Puerto Principe, Cuba.

A correspondent incloses the following clipping from a recent issue of the Detroit (Mich.) *Free Press:* "The Detroit City Gas Company has filed a bill asking for an injunction restraining the Gas Consumers' Association and its Agent, A. M. Whiteley, from interfering with pipes which complainant alleges to be its property—the pipes in question are the service pipes from the meters to the house pipes. Complainant alleges that the defendant Company is proprietor of a gas regulator which is now on sale in Detroit, and of which a number are now in use. In putting on these regulators, it is averred that the defendants cut the pipes of complainant and do not afterwards make the fastenings secure and tight, so that gas escapes, to the loss of complainants and to the danger of their employees. Complainants say they have offered the defendants to permit them to put in the regulators, if they would notify complainants so that the latter could send along an inspector to see that the work was properly done. Defendants, though, were asked to pay the expenses of this inspector, and they declined to have anything to do with the complainants in the premises. Judge White ordered the issuance of a temporary injunction."

Mr. M. T. Walker, of Anniston, Ala., has been appointed to supervise the plants of the Rockville (Conn.) Gas and Electric Light Company, vice Mr. D. F. Burritt, resigned.

Advices from Buffalo, N. Y., are to the effect that in a short time the plant of the Buffalo Mutual Gas Light Company will shut down. In that event the entire output will come from the plant of the original Buffalo Gas Light Company, at Genessee and Jackson streets.

At the annual meeting of the shareholders in the Washington (D.C.) Gas Light Company the Directors elected were: John R. McLean, John C. Bullitt, James W. Orme, George T. Dunlop and Richard H. Goldsborough—the latter was named to the vacancy caused by the death of Capt. Rodgers.

Mr. Edward Moir, of Syracuse, N. Y., is in full charge as Receiver for the properties of the Clyde (N. Y.) Gas and Electric Company.

From the annual report of the Capital City Gas Light Company, of Des Moines, Iowa, it is learned that the sum of $62,183 93 was expended on the plant last year. Main extensions absorbed $13,917.29; betterments, $31,719.39; repairs and replacements, $16,547.30.

At the 18th annual meeting of the Independence (Mo.) Gas and Coke Company the report of Secretary R. D. Wirt, covering the Company's

operations for the last year, showed satisfactory conditions respecting its plant and business. The following Directors were elected: C. C. Childs, D. Bullard, W. H. Wagoner, J. W. Mercer and R. D. Wirt.

THE Stevens Gas Improvement Company has been incorporated, under the laws of West Virginia, with a capital of $220,000. Its head quarters are to be in New Castle, Pa., where it proposes to engage in the business of manufacturing gas machinery. The incorporators are Eli Stevens and R. T. Van Valkenberg, of Muncie, Ind.; and J. E. Duff, Samuel McCreary and R. D. Crawford, of New Castle.

THE franchise for the construction and operation of a gas plant in La Grange, Ills., has been issued to Mr. I. C. Copley, of Aurora, Ills. Work on construction account will not be undertaken until Mr. Copley's return from Europe—likely in October next.

MR. FRANK B. POOR, President of the Hackensack (N. J.) Gas and Electric Company, recently addressed the following self-explanatory circular to "All employees of the Gas and Electric Company, of Bergen County, N. J.," of which Company Mr. Poor is also President: "With a view of increasing your interest in the progress of the Company, I have decided to make the following offer: If at the end of the present year the earnings of your department reach a figure given to your Engineer, I will give $1,250 to each department, to be divided according to the quality of the work and interest in the Company that each man has shown. The figure that I have taken calls for a good increase in our business, but with energy it can easily be bettered. In order to make the offer fair both to yourself and myself, should the earnings fall below my figure, I shall deduct from this bonus $50 for each $1,000 that our earnings fall short, and if they show an increase, as I hope and believe they will, I will add $100 for each $1,000 over." All of which seems to constitute a most liberal proposition, to which also attaches the merit of novelty.

A CORRESPONDENT in Wheeling, West Va, forwards the following: "The effect of incandescent gas light as a stimulus to plant growth has been made the subject of study by the horticulturist at the West Virginia Agricultural Experiment Station, at Morgantown, and the last bulletin issued on that subject (No. 62) gives an account of the behavior of plants when placed under the stimulus of this light for various purposes. Perhaps I could not do better than to repeat the summary as stated in the bulletin. While it does not explain the methods employed, it sets forth the conclusions which were arrived at during the course of the experiment:

"1. The incandescent gas light of the Welsbach burner is an active stimulus to plant growth when used at night to supplement daylight.

"2. Lettuce plants subjected to the influence of the incandescent gas light at night were taller and heavier than plants of the same variety and seed sowing grown in normal conditions.

"3. That lettuce and spinach subjected to the stimulating influence of the light grew faster and completed their growth in less time than plants of the same sorts from the same seed sowing grown in normal conditions.

"4. That no injurious effects resulted from the use of incandescent gas light.

"That the stimulating influence of the light, as indicated by the growth of plants used in the various tests, is shown by the order in which the sorts are named, the first being the most susceptible—spinach, cabbage, radish, lettuce and tomato.

"6. That the range of light is somewhat variable for the different crops. In general the maximum growth was obtained at 12 to 16 feet from the light, while a perceptible increase was noticed at 24 feet.

"7. Bloom record of tomatoes shows markedly earlier bloom in the light house—8 days the least and 18 days the greatest difference.

"8. That in the case of radishes top growth was stimulated, but evidently not markedly at the expense of root. With sugar beets top growth was greatly stimulated, evidently at the expense of root growth.

"9. That while the roots of beets grown in the normal house were larger than those in the light house, the sugar content and the per cent. purity were markedly higher in the light house grown beets.

"10. Spinach, lettuce and radishes all tend to make seed stalks under the light than in normal conditions.

"11. Lettuce and spinach, under the influence of the incandescent gas light, not only grew faster during the growing period, but the period was actually longer than for plants in the normal house."

THE first week this month the papers of Boston reported that severe damage had been done to the plant of the Charlestown (Mass.) Gas and Electric Company through "the explosion of a gas tank." There was a disturbance on the plant in question at the time named, and it was caused by the displacement of an air chamber attached to a steam pump for conveying naphtha to the generators of the water gas plant. The loss occasioned did not amount to $10.

THE Berlin Iron Bridge Company, of East Berlin, Conn., has just completed two large highway bridges at Long Lake, N. Y., and is now putting up a 200 ft. span at Stuyvesant Falls, N. Y., a large highway bridge at Hillsborough, N. H., and a 2 span trolley bridge across the Naugatuck river, at Waterbury, Conn.

MR. KIESEWETTER, who is prominent in the ownership of the Columbus (O.) Edison Electric Light Company, denies that there is any likelihood of its consolidation with the Columbus Gas Light and Heating Company.

MR. JOHN J. CUMMINS, of Syracuse, N. Y., has been named to take charge of the business of the Syracuse Gas Company and of the Syracuse Electric Light Company, until the formal consolidation of the two concerns has been perfected.

COUNCILMAN ROY, of Atlanta, Ga., wants the office of gas inspector for that city created. He proposes that the salary attached to the job shall be not less than $720, and that it shall "be paid by the gas companies doing business in the city."

A RECENT issue of the Evansville (Ind.) *Courier* said: "The Peoples Electric Light and Power Company, of this city, will go out of business March 1st. Notice to this effect was given on the 3rd inst. The engines, dynamos and boilers will be removed from the city and shipped to the purchasers who are not known here. The first intimation of this step was given when Mr. H. J. Miller, of Fort Wayne, Ind., administrator of the estate of the late Mr. R. T. McDonald, the virtual owner of the plant, came to Evansville. He ordered the plant to be shut down March 1st, and the machinery shipped away. He said the plant was not a profitable investment in the first place, and in the second place the estate had to be settled up, and the only way to do that was to quit business. Mr. McDonald died in December, 1898, and had interests in various parts of the country, all the way from Texas to Maine. The Evansville plant was established in 1889, the power house being at the corner of Lafayette and Olive streets. Since 1891 Mr. J. J. Nolan has been manager and the plant has increased in size and in business greatly during that time. Mr. Nolan has simply been manager, and is not and never has been a stockholder in the Company. The Company has about 2,500 incandescents and 75 arcs and furnishes 100-horse power to a number of small shops, while in the summer many fans were on its lines. This exodus will leave the Evansville Gas and Electric Light Company the sole supplier of electric currents to the city."

THE correspondent who forwarded the above says: "I think this is an original instance in the history of electric lighting. Many consolidations have been, and are being made as between gas companies and electric companies, but I have not before heard of anything like the Evansville instance. The Evansville Gas and Electric Light Company has been in competition with the People's Electric Light and Power Company since 1889. Aside, I might remark that if the gas consumption in Evansville increases each month in 1900 like it increased the first month of the year, the end of the century year will be a great one for the gas man."

WRITE to the Detroit Stove Works, of Detroit and Chicago, for a copy of its attractive pamphlet on "Cooking by Gas." Small in compass, excellent in typography, solid in matter, it is a jewel.

MR. ALLEN SHEWMON, of Racine, Wis., is considering the advisability of establishing a gas plant in Great Falls, Montana. To say the least, Mr. Shewmon must have great faith in his belief, when he persuades himself that an enterprise of the sort named would pay in the place named.

AT the annual meeting of the People's Gas Light and Coke Company of Chicago, the annual reports showed that its affairs are in a very satisfactory condition. The output during 1899 was 6,879,419,985 cubic feet, as against 6,114,587,380 cubic feet in 1898. The percentage of earnings was 6.84 per cent. in 1899, as against 6 51 per cent. in 1898. The Directors elected were: C. K. G. Billings and F. S. Winston, of Chicago; and A. N. Brady, A. R. Flower and Walton Ferguson, of New York. The report of President Billings to the shareholders noted that in addition to the acquirement of the properties of the Calumet Gas Company (Jan. 1899), the Company had taken over the gas properties of the Pullman Palace Car Company, September 1st, 1899. He also said: "Since the Company has been placed, through consolidation, upon a strong legal and financial basis, it has been the policy of the management, while paying a reasonable return upon the money invested in its stock, to also give the public some of the benefits accruing through the consolidation into one Company of the various gas companies. The heavy expenditures during 1899 in the extension of the Company's plant and mains have been of enormous advantage to to the citizens of the territory affected. Reference was made in the last annual report to the extension of the use of gas for fuel purposes through the introduction of gas stoves. How active our work has been in this direction is shown by the fact that we have sold and set during the year 1899 over 27,000 additional gas stoves. The increase in the number of meters set during the year was 44,441, of which 5,328 measure the consumption of natural gas, 2,148 were taken over with the Calumet Gas Company, 907 with the gas plant bought from the Pullman Company, and the remainder, 36,058, are new meters set for manufactured gas." Further interesting figures concerning the Company are the following: Mileage of mains and number of meters, gas stoves and public lamps in service Dec. 31, 1899.—Street mains, 1,705 miles, 3,795 feet; gain, 121 miles, 1,199 feet; meters, 274,604; gain, 44,311; gas stoves, 47,639; gain, 27,296; public lamps, 25,121; loss, 2,902.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

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ELBERT P. CALLENDER,
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New York—American News Co. 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, FEB. 19, 1900.

The Market for Gas Securities.

The main item of interest this week in connection with the local gas industry was the announcement, by Mr. H. E. Gawtry, President of the Consolidated Gas Company, that the Directors had secured control of about all the electric lighting interests on Manhattan Island, and that the Consolidated shareholders would be "asked" to ratify the purchase, at a special meeting, to be held March 9th. The ratification means an expression that the Company may take over the several electric lighting properties through the issue of 155,172 shares of Consolidated Company's stock, at a "parity" of $232 per share. The deal is a queer one. Some of the "electrical securities" thus acquired are shares of the "Brush Electric Illuminating Company."

President Gawtry's circular starts in the paragraph: "The rapid growth of electricity for light and power is observed by everyone, and the annual consumption of gas *per meter* for light is gradually but surely diminishing." How much has *the output* of gas diminished during the year? And where would the electricians be if the 65 cent per 1,000 cubic feet rate for gas were continued, say until two years from the present?

The general gas market is fairly strong, and particularly so in respect of anything that has good property behind it.

Brooklyn Union has halted a trifle in the rise that is sure to come with it when the New York city proper fiasco is settled. Bay State is weak and dull, with very little prospect of its taking on anything of permanent value. Baltimore Consolidated is in fair demand.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

FEB. 19.

☞ All communications will receive particular attention

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$39,078,000	100	193½	194
Central Union, Bonds, 5's	3,000,000	1,000	107½	108½
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	115	18
Metropolitan Bonds	658,000	.	108	112
Mutual	3,500,000	100	275	300
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	
New Amsterdam Gas Co.	13,000,000	100	25½	26½
Preferred	10,000,000	100	44	45
Bonds, 5's	11,000,000	1,000	96	96½
Northern Union, Bonds, 5's	1,250,000	1,000	95	97
New York and East River				
Bonds 1st 5's	3,500,000	1,000	109	111
" 1st Con. 5's	1,500,000	..	115	..
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	100	117
Preferred	5,000,000	100	140	148
Bonds, 1st Mortgage, 5's	1,500,000	1,000	110	114
Yonkers	299,65	500	130	.
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	147	150
" " Bonds (5's)	15 000,000	1,000	118	119
Bay State	50,000,000	50	1¾	1⅞
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	40	..
" 1st Mtg. 5's	475,000	1,000	96½	99½
Boston United Gas Co.—				
1s Series S. F. Trust	7,000,000	1,000	92	..
2d " " "	3,000,000	1,000	68	..
Buffalo City Gas Co.	5,500,000	100	5	8
" " Bonds, 5's	5,250,000	1,000	72	75
Central, San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,207,000	1,000	106	108
Columbus (O.) Gas Lt. & Heating Co	1,682,780	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,090	1,000	102	105
Cincinnati G. & C. Co.	8,500,000	100	193½	194½
Consumers, Toronto	1,700,000	50	230	235
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Consolidated, Baltimore	11,000,000	100	58¾	59
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	21	23
" Con. Mtg. 5's	380,000	1,000	87	90
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,560,000	50	95¾	96
" Prior Lien 5's	4,598,000	1,000	99½	100
Detroit Gas Co., 5's	386,000	1,000	100	101
" Inc. 5's	16,000	100	100⅛	101
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	38	45
" Bonds	2,000,000	..	60	64
Grand Rapids Gas Lt. Co.	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	..
Hartford	750,000	25	..	220
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	102	105
Indianapolis	2,000,000	..	100	105
" Bonds, 6's	2 650,000	..	101	103
Jackson Gas Co.	250,000	50	72	78
" 1st Mtg. 5's	250,000	1,000	101	102½
Lafayette Gas Co., Ind.	1,000,000	100	40	45
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	106	
Laclede, St. Louis	7,500,000	100	76	76¼
Preferred	2,500,000	100	95	100
Bonds	10,000,000	1,000	110	110½
Madison Gas & Elec. Co.	400,000	100	82	..
" 1st Mtg. 6's	350,000	1,000	102½	108
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co.	16,000,000	..	50	60
Bonds, 6's	4,600,000	..	107	108
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	43	45
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	105	105½
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	111⅜	111½x
2d "	2,500,000	1,000	104	105
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	49	50
St. Paul Gas Light Co.	1,500,000	100	57½	58½
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,428,000	1,000	88	90½
St. Joseph Gas Co.	1,000,000	100	42	44
" 1st Mtg. 5's	750,000	1,000	96½	98
Syracuse, N. Y.	1,750,000	100	..	15
Bonds	1,612 000	1,000	85	90
Washington, D. C	2,000,000	20	285	..
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	106¾	107¾
Bonds, 5's	3,880,500	.	106	108
Wilmington, Del.	600,000		220	50

Advertisers' Index.

GAS ENGINEERS.

	Page
Wm. Henry White, New York City	315
Fred. Bredel, Milwaukee, Wis.	302
Geo. R. Rowland, New York City	313
The Western Gas Construction Co., Fort Wayne, Ind.	280
Humphreys & Glasgow, New York City	313
American Gas Co., Phila., Pa.	302
David Leavitt Hough, New York City	312
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	299
Baxter & Young, Detroit, Mich.	312
United Gas Improvement Co., Phila., Pa	307
James T. Lynn, Detroit, Mich.	312
A. E. Boardman, Brevard, N. C.	312

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd's Sons, New York City	316
Continental Iron Works, Brooklyn, N. Y.	314
Deily & Fowler, Phila., Pa.	316
Kerr Murray Mfg. Co., Fort Wayne, Ind	312
Stacey Mfg. Co., Cincinnati, Ohio.	315
Bartlett, Hayward & Co., Baltimore, Md.	313
Davis and Farnum Mfg. Co., Waltham, Mass.	312
R. D. Wood & Co., Phila., Pa.	314
Isbell-Porter Company, New York City	314
Fred. Bredel, Milwaukee, Wis.	302
United Gas Improvement Co., Phila., Pa.	307
National Gas and Water Co., Chicago, Ills.	309
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	299
The Western Gas Construction Co., Fort Wayne, Ind.	280
Humphreys & Glasgow, New York City	313
American Gas Co., Phila., Pa.	302
Logan Iron Works, Brooklyn, N. Y.	316
Riter-Conley Mfg. Co., Pittsburgh, Pa.	315
Baxter & Young, Detroit, Mich.	312
Berlin Iron Bridge Co., East Berlin, Conn.	301
G. Shepard Page's Sons, New York City	312
James T. Lynn, Detroit, Mich.	312
A. E. Boardman, Brevard, N. C.	312
Sutherland Construction & Improvement Co., N.Y. City	300
Chris. Cunningham & Son, Brooklyn, N.Y.	297

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md.	313
United Gas Improvement Co., Phila., Pa.	307
Burdett Loomis, Hartford, Conn.	314
National Gas and Water Co., Chicago, Ills.	309
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	299
The Western Gas Construction Co., Fort Wayne, Ind.	280
Humphreys & Glasgow, New York City	313
Sutherland Construction & Improvement Co., N.Y. City	300
B. E. Chollar, St. Louis, Mo.	300

SCRUBBERS AND CONDENSERS.

R. D. Wood & Co., Phila., Pa.	314
James R. Floyd's Sons, New York City	316
Continental Iron Works, Brooklyn, N. Y.	314
Logan Iron Works, Brooklyn, N. Y.	316
Riter-Conley Mfg. Co., Pittsburgh, Pa.	315

TAR AND CARBONIC ACID EXTRACTOR.

R. D. Wood & Co., Phila., Pa.	314

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich..... 296
American Gas Company, Phila., Pa..... 302

GAS METERS.

John J. Griffin & Co., Phila., Pa..... 320
American Meter Co., New York and Philadelphia..... 319
Helme & McIlhenny, Phila., Pa..... 319
D. McDonald & Co., Albany, N.Y..... 317
Nathaniel Tufts Meter Co., Boston, Mass..... 318
Maryland Meter and Mfg. Co., Baltimore, Md..... 318
Metric Metal Co., Erie, Pa..... 319
Keystone Meter Co., Royersford, Pa..... 318
Detroit Meter Company, Detroit, Mich..... 279

PREPAYMENT METERS.

American Meter Co.. New York and Philadelphia..... 319
John J. Griffin & Co., Phila., Pa..... 320
D. McDonald & Co., Albany, N. Y..... 317
Helme & McIlhenny, Phila., Pa..... 319
Nathaniel Tufts Meter Co., Boston, Mass..... 318

GAS AND WATER PIPES.

M. J. Drummond & Co., New York City..... 317
R. D. Wood & Co., Phila., Pa..... 314
Warren Foundry and Machine Co., New York City..... 317
Donaldson Iron Co., Emaus, Pa..... 317
Chris. Cunningham & Son, Brooklyn, N.Y..... 297

PIPE CUTTERS.

The Anderson Pipe Cutter Co., East Boston, Mass..... 296

GAS MAIN STOPPERS.

Safety Gas Main Stopper Co., N. Y. City..... 299

GAS TAPPING MACHINES.

George Light, Dayton, O..... 295

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, Brooklyn, N. Y..... 309

GAS COALS.

Penn Gas Coal Co., Phila., Pa..... 311
Perkins & Co., New York City..... 310
Despard Gas Coal Co., Baltimore, Md..... 311
Westmoreland Coal Co., Phila., Pa..... 311
Berwind-White Coal Mining Co., New York and Phila... 310

CANNEL COALS.

Perkins & Co., New York City..... 310

CONVEYORS.

The Link-Belt Machinery Co., Chicago, Ills..... 299

GAS ENRICHERS.

Standard Oil Co., New York City..... 311
The Sun Oil Co., Pittsburgh, Pa..... 311

COKE CRUSHER.

C. M. Keller, Columbus, Ind..... 311

GAS GAUGES.

The Bristol Co., Waterbury, Conn..... 301

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City 309
Isbell-Porter Co., New York City..... 314
R. D. Wood & Co., Phila., Pa..... 314
Wm M. Crane Co., New York City..... 297

CEMENTS.

C. L. Gerould, Galesburg, Ills..... 308

RETORTS AND FIREBRICKS.

J. H. Gautier & Co., Jersey City, N. J..... 308
Adam Weber, New York City..... 308
Laclede Firebrick Mfg. Co., St. Louis, Mo..... 308
Cyrus Borgner, Phila., Pa..... 308
James Gardner, Jr., Pittsburgh, Pa..... 308
Henry Maurer & Son, New York City..... 308
Baltimore Retort and Firebrick Co., Baltimore, Md..... 308
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 308
Brooklyn Firebrick Works, Brooklyn, N. Y..... 308

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md..... 313
Fred. Bredel, Milwaukee, Wis..... 302
J. H. Gautier & Co., Jersey City, N. J..... 308
Parker-Russell Mining and Mfg. Co., St. Louis, Mo..... 308
Adam Weber, New York City..... 308

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Co., New York City..... 314
Continental Iron Works, Brooklyn, N.Y..... 314
Logan Iron Works, Brooklyn, N. Y..... 316
R. D. Wood & Co., Phila., Pa..... 314

INCANDESCENT GAS LAMPS.

Welsbach Commercial Co., Phila., Pa..... 306

BURNERS.

C. A. Gefrorer, Phila., Pa..... 314
Wm. M. Crane Co., New York City..... 299
D. M. Steward Mfg. Co., Chattanooga, Tenn..... 299

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn..... 299

STREET LAMPS.

Welsbach Street Lighting Co., New York and Phila..... 304
Thos. T. W. Miner, New York City..... 296

PURIFIERS.

Stacey Mfg. Co., Cincinnati, O..... 300

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 309

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y..... 301
Chapman Valve Manufacturing Co., Boston, Mass..... 301
R. D. Wood & Co., Phila., Pa..... 314
Continental Iron Works, Brooklyn, N. Y..... 314
The P. H. & F. M. Roots Co., Connersville, Ind..... 303
Isbell-Porter Co., New York City..... 314
The Western Gas Construction Co., Fort Wayne Ind.... 280

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind..... 303
Isbell-Porter Company, New York City..... 314
Connelly Iron Sponge and Governor Co., New York City 309

ELECTRICAL APPARATUS.

Wm Henry White, New York City..... 315

ENGINES AND BOILERS.

The Hazelton Boiler Company, New York City..... 296

PURIFIER SCREENS.

John Cabot, New York City..... 301

GAS STOVES.

American Meter Co., New York and Philadelphia..... 305
Maryland Meter and Manufacturing Co., Baltimore, Md. 318
Keystone Meter Co., Royersford, Pa..... 318
Wm. M. Crane Co., New York City..... 297
Nathaniel Tufts Meter Co., Boston Mass..... 318
National Stoves, Lorain, O..... 296
Abendroth Brothers, Port Chester, N. Y..... 296
Detroit Stove Works, Detroit, Mich..... 298

HOT WATER HEATERS.

Wm. M. Crane Co., New York City..... 297

GASHOLDER TANKS.

J P. Whittier, Brooklyn, N. Y..... 313

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md..... 313
Continental Iron Works, Brooklyn, N. Y..... 314
Deily & Fowler, Philadelphia, Pa..... 316
Davis & Farnum Mfg. Co., Waltham, Mass..... 312
Kerr Murray Mfg. Co., Fort Wayne, Ind..... 312
Stacey Mfg. Co., Cincinnati, Ohio..... 315
R. D. Wood & Co., Philadelphia, Pa..... 314
Logan Iron Works, Brooklyn, N. Y..... 316
Riter-Conley Mfg. Co., Pittsburgh, Pa..... 315
Chris. Cunningham & Son, Brooklyn, N.Y..... 297

GAS SECURITIES.

Henry Marquand & Co., New York City..... 296

ADVERTISING.

J. Howland Harding, New York City..... 296

BOOKS, ETC.

Newbigging's Handbook..... 304
Field's Analysis, 1898..... 221
Scientific Books..... 310
Digest of Gas Cases..... 311
Practical Photometry..... 308
Gas Flow Computers..... 318
Hughes' "Gas Works"..... 309
Gas Engineer's Pocket-Book..... 220
Excerpts from Reports of Gas Commissioners..... 233
Poole on Fuels..... 319
Binders..... 317
Directory of Gas Companies..... 315
Practical Handbook on Gas Engines..... 304
Coal Tar Tree..... 300

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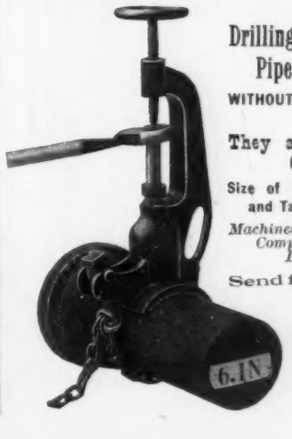

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Saltley Works, Birmingham, Eng.	2,000,000
Colchester, Eng.	300,000
Birkenhead, Eng.	2,250,000
Swindon (New Swindon Gas Co.), Eng.	120,000
Saltley Works, Birmingham, Eng. (2d Contract)	2,000,000
Windsor St. W'ks, Birming'm, Eng. (2d Contract)	2,000,000
Halifax, Eng.	1,000,000
Toronto,	250,000
Ottawa,	250,000
Toronto (Second Contract, Remodeled),	2,000,000
Lindsay (Remodeled),	125,000
Belleville,	250,000
Ottawa (Second Contract),	250,000
Brantford (Remodeled)	200,000
St. Catherine's (Remodeled),	250,000
Kingston, Pa.	125,000
Montreal,	500,000
Peterborough, Ont.	250,000
Wilkesbarre, Pa.	750,000
St. Catherine's (Second Contract),	250,000
Buffalo, N. Y.	2,000,000
Winnipeg, Man.	500,000
Colchester, Eng. (Second Contract),	300,000
York, Eng.	750,000
Rochester, Eng.	500,000
Kingston, Ont.	300,000
Crystal Palace District, Eng.	2,000,000
Duluth, Minn.	300,000
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Enschede, Holland,	150,000
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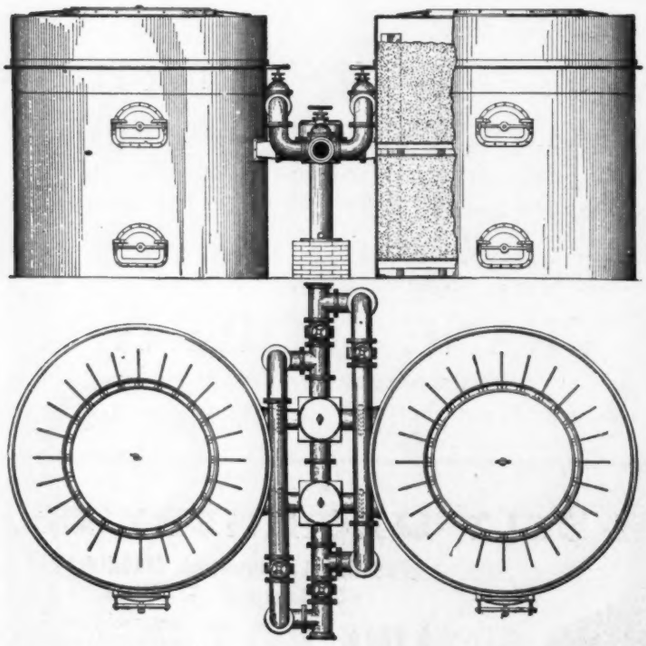

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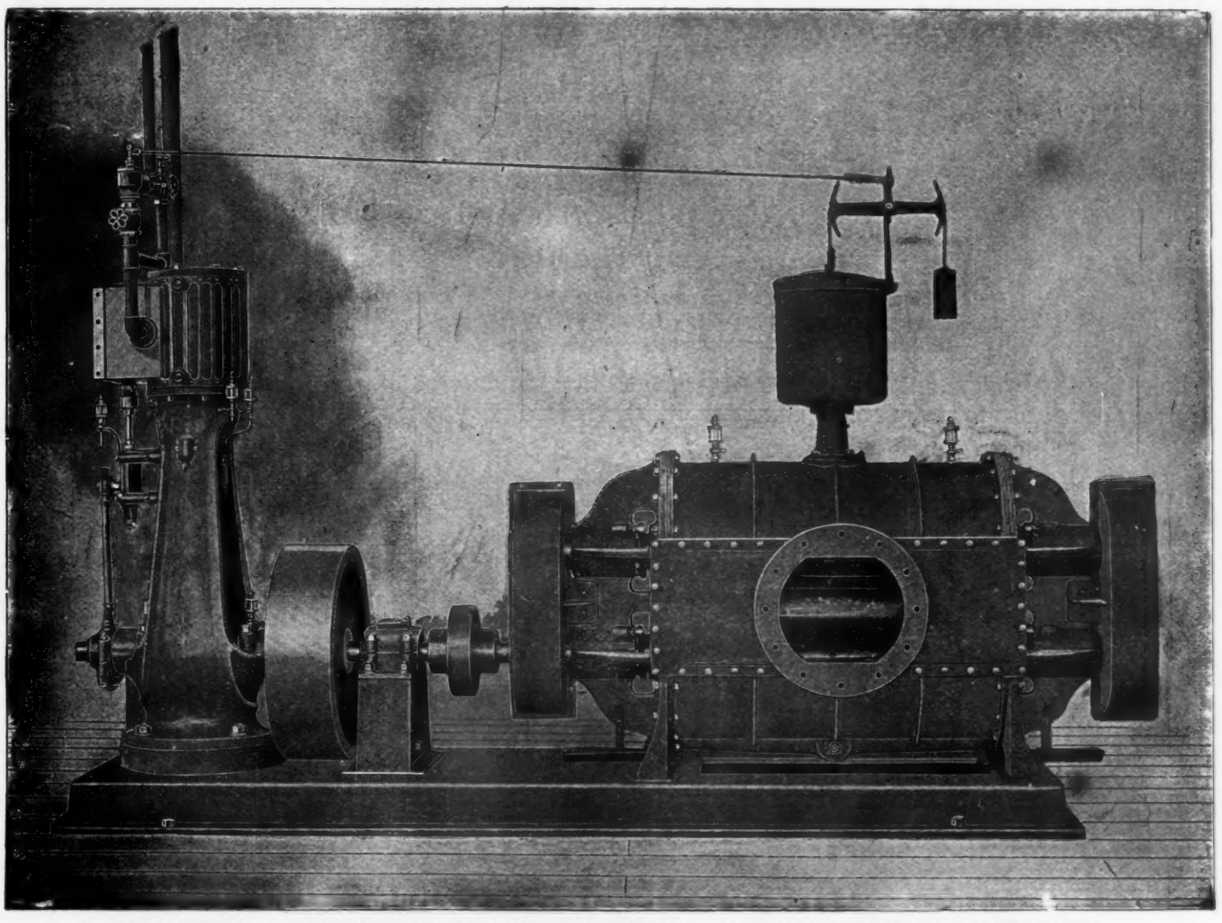

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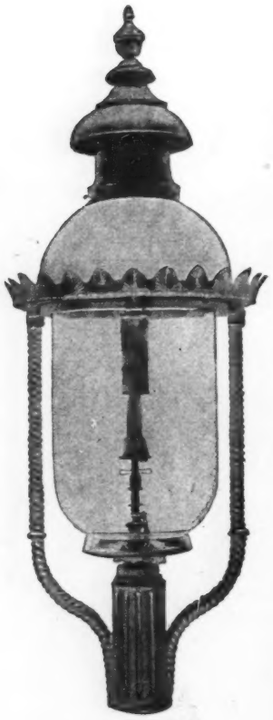

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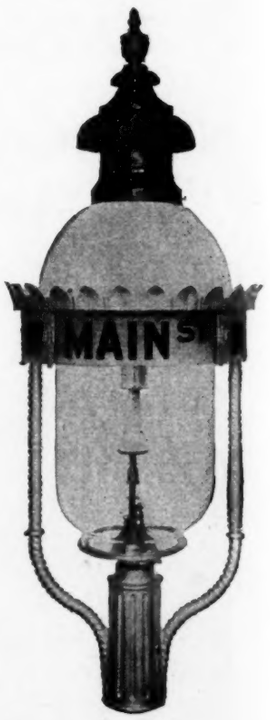

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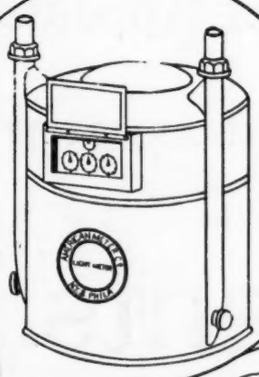
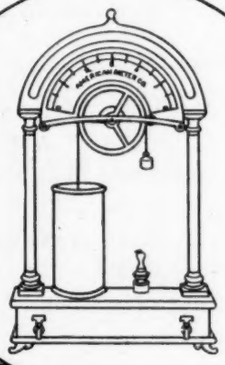
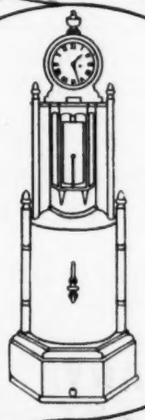
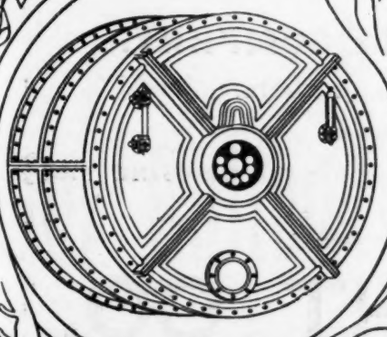








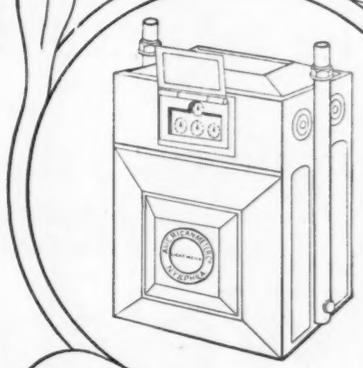
PUBLIC LIGHTING TABLE.

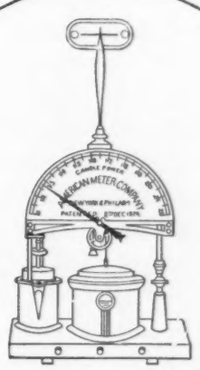
MARCH, 1900.

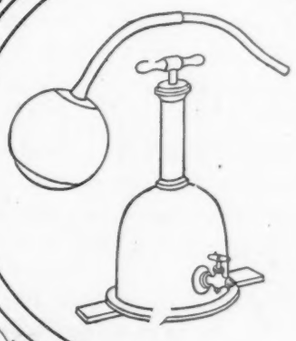
Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.	Table No. 2. NEW YORK CITY. ALL NIGHT LIGHTING. Light.	Extinguish.
				P.M.	A.M.
Thu.	1	6.20 PM	5.30 AM	5.30	5.45
Fri.	2	6.20	5.30	5.30	5.45
Sat.	3	6.20	5.30	5.30	5.45
Sun.	4	6.20	5.20	5.30	5.45
Mon.	5	10.20	5.20	5.40	5.35
Tue.	6	11.30	5.20	5.40	5.35
Wed.	7	12.30 AM FQ	5.20	5.40	5.35
Thu.	8	1.20	5.20	5.40	5.35
Fri.	9	2.00	5.20	5.40	5.35
Sat.	10	2.40	5.20	5.40	5.35
Sun.	11	3.10	5.10	5.40	5.35
Mon.	12	3.40	5.10	5.50	5.20
Tue.	13	4.00	5.10	5.50	5.20
Wed.	14	No L.	No L.	5.50	5.20
Thu.	15	No L. FM	No L.	5.50	5.20
Fri.	16	No L.	No L.	5.50	5.20
Sat.	17	6.40 PM	8.40 PM	5.50	5.20
Sun.	18	6.40	9.40	5.50	5.20
Mon.	19	6.40	10.40	6.00	5.10
Tue.	20	6.40	11.40	6.00	5.10
Wed.	21	6.40	12.40 AM	6.00	5.10
Thu.	22	6.40	1.40	6.00	5.10
Fri.	23	6.40 LQ	2.30	6.00	5.10
Sat.	24	6.40	3.10	6.00	5.10
Sun.	25	6.50	4.00	6.00	5.10
Mon.	26	6.50	4.30	6.10	4.55
Tue.	27	6.50	4.50	6.10	4.55
Wed.	28	6.50	4.50	6.10	4.55
Thu.	29	6.50	4.50	6.10	4.55
Fri.	30	6.50 NM	4.50	6.10	4.55
Sat.	31	6.50	4.50	6.10	4.55

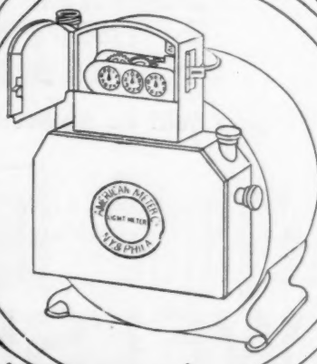
TOTAL HOURS LIGHTING DURING 1900.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	230.50	January	423.20
February	175.40	February	355.25
March	189.00	March	355.35
April	160.30	April	298.50
May	150.40	May	264.50
June	137.00	June	234.25
July	152.00	July	243.45
August	171.50	August	280.25
September	187.20	September	321.15
October	213.10	October	374.30
November	221.50	November	401.40
December	231.50	December	433.45
Total, yr.	2221.40	Total, yr.	3987.45









THE RECENT DECISION.

The United States Circuit Court of Appeals,

In Its Opinion of December 7, 1899,

FINALLY AND FULLY SUSTAINS THE WELSBACH COMPANY'S PATENT.

DEALERS and USERS and MANUFACTURERS are CAUTIONED against INFRINGEMENT of the

Welsbach Patents.

Judge LACOMBE, in the United States Circuit Court, handed down the following opinion Saturday, Dec. 9, 1899.

On motion to restrain complainant from sending circulars to the customers of American Incandescent Lamp Company.

LACOMBE, Circuit Judge.

Irrespective entirely of the preliminary objection that affirmative relief of this sort will not be granted to defendant—a question not now passed upon—there seem no good grounds for criticism of complainant's circular. It states that Judge Townsend enjoined the "manufacture and sale" of infringing mantles; and he did grant such an injunction. And this Court has enjoined the sale of mantles which the person enjoined did not himself manufacture, when his past conduct in the matter of infringement created a special equity in favor of the complainant against him. It is true that the circular goes further, and threatens suit against persons who sell mantles, but who never have been at all concerned in manufacturing or causing them to be manufactured.

In other words, it threatens suit upon the patent as if it were a patent for a product. But the complainant insists that the threat is made in good faith; that it intends to bring suits against sellers of the infringing mantles upon the theory that the patent is really one for a product. In view of the peculiar language of the claim, this Court is not now prepared to hold that such contention would be wholly without merit, or that the complainant could not succeed against a mere seller. Moreover, it is contended that the seller of a purchased mantle himself promotes the taking of the final step in the process, and such contention has not yet been passed upon adversely to complainant. These are questions which should be left to be determined in one of such suits, rather than here. If complainant intends to prosecute one or more sellers, and there is nothing before the Court to induce a disbelief in its assertion that it does so intend, it would seem to be its proper course to warn dealers to desist from selling.

December 9, 1899.

Restraining orders issued in the United States Circuit Courts against—

THE UNITED INCANDESCENT LIGHT COMPANY.
ST. LOUIS INCANDESCENT MANTLE COMPANY.
ECKERLE ELECTRICAL COMPANY.
H. KUPFER.
THE NEWBY INCANDESCENT MANTLE COMPANY.

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TO THE PUBLIC: Avoid Liability of infringement! Take nothing but the GENUINE always in sealed boxes bearing our registered trademark, "WELSBACH."

WELSBACH LIGHT CO.

Salesrooms in all the leading cities throughout the United States.

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THE STANDARD JUNIOR,

THE STANDARD DOUBLE SUPERHEATER,

LOWE WATER GAS APPARATUS.

Total Sets Installed to January 1, 1900, - - - - - - - - 327

Total Daily Capacity - - - - - - - - - 207,425,000 Cu. Ft.

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H. D ABERNETHY. Sec.

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FIRE BRICK and FIRE CLAY SPECIALTIES.

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

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In Kegs less than 100 " " 7 " "

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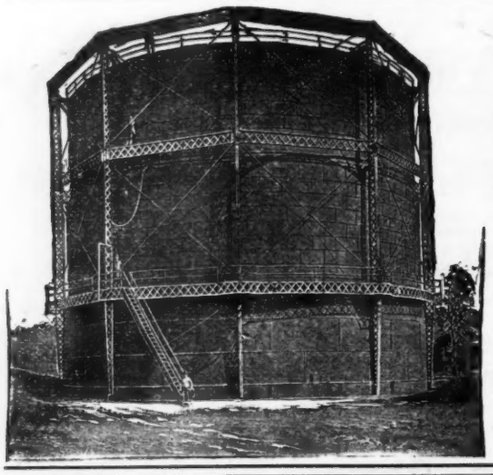

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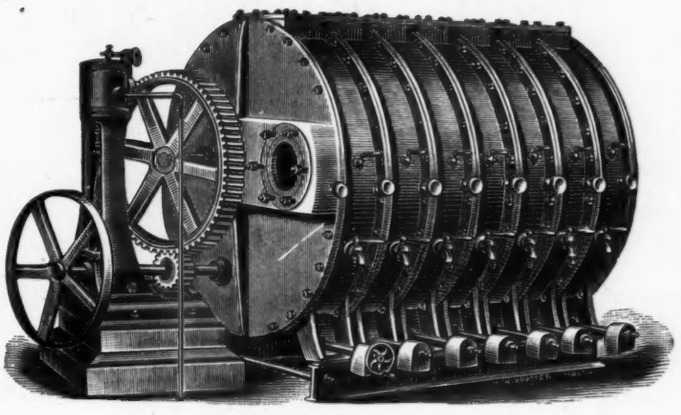

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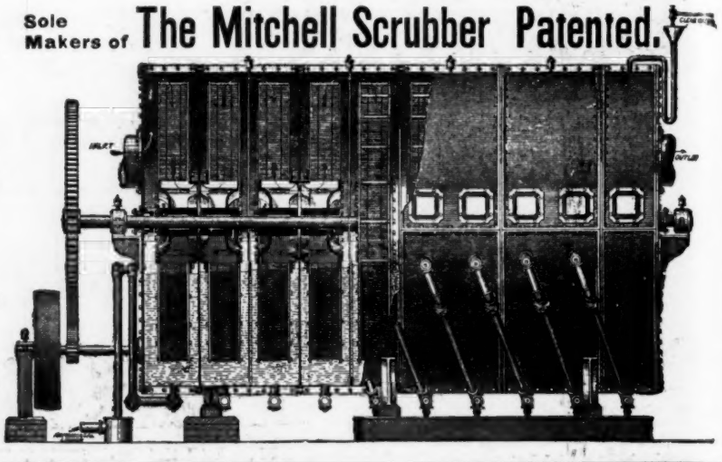

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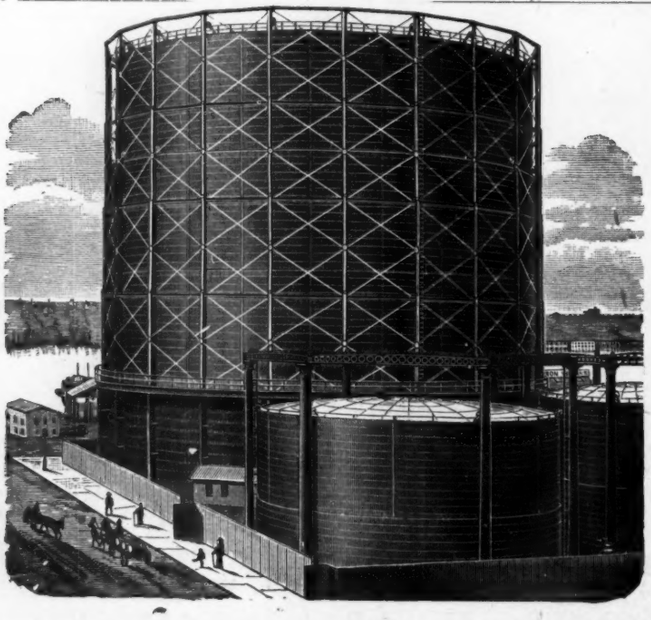

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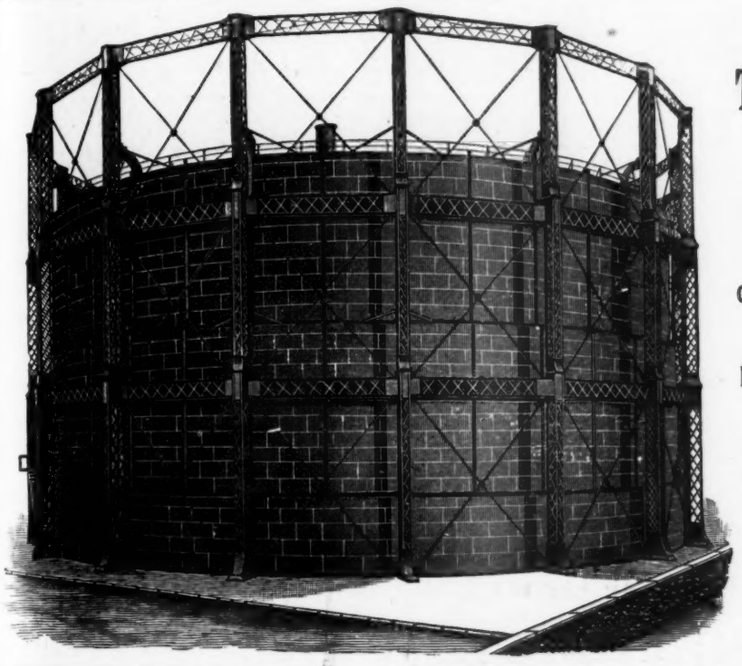

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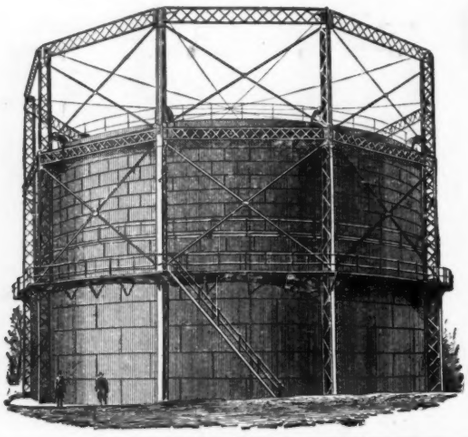

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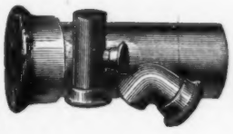

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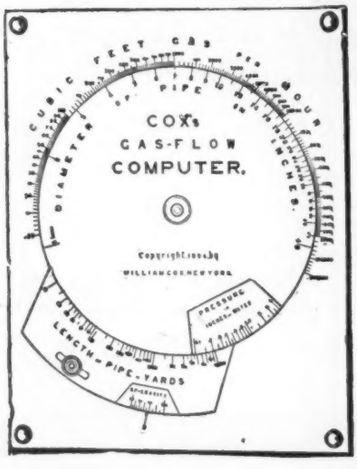

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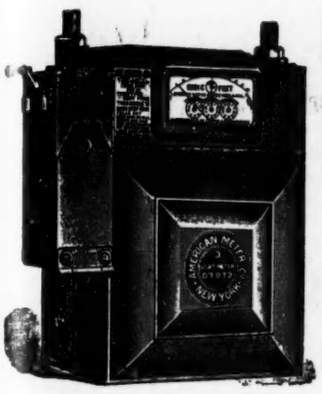

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